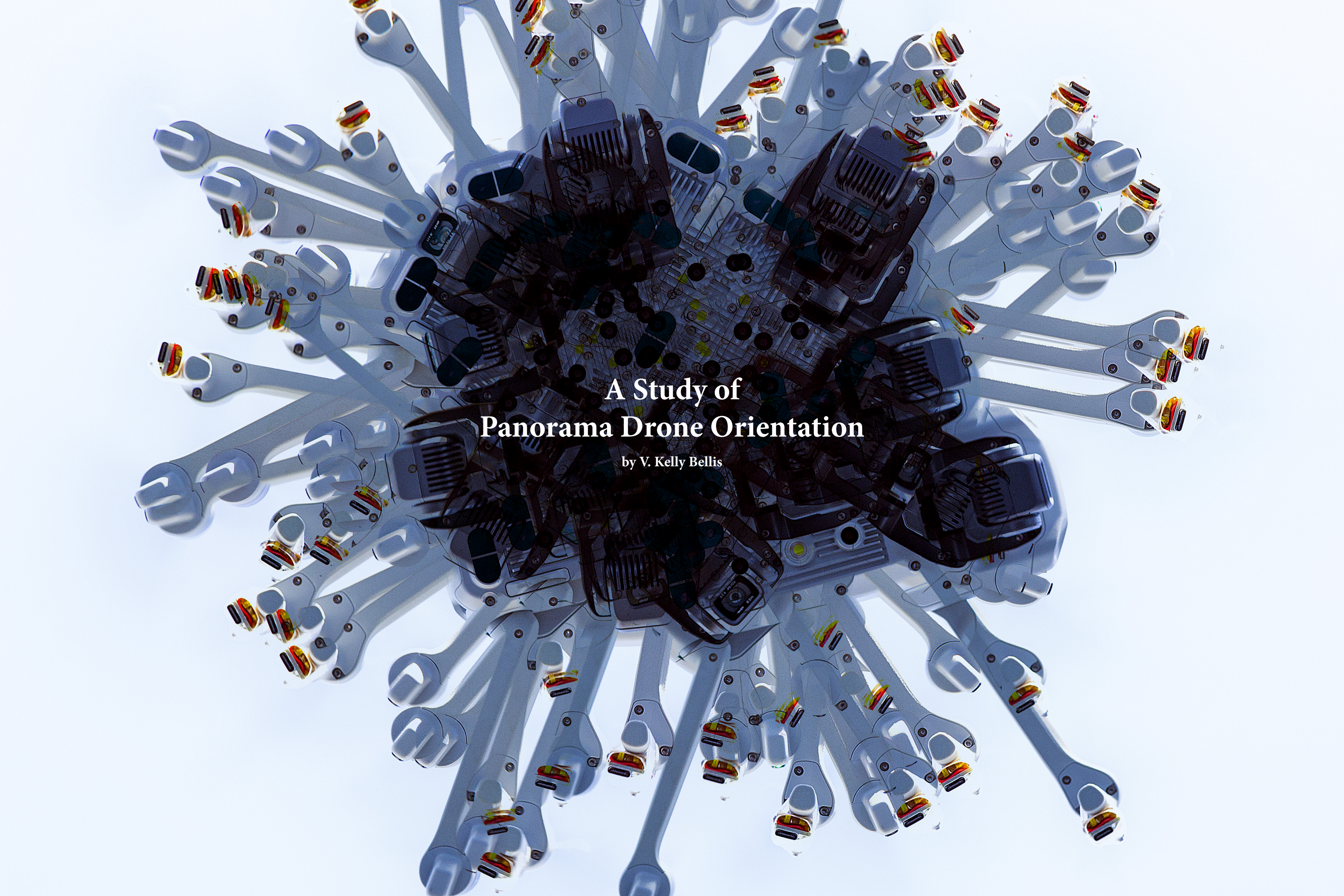




A Study of Panorama Drone Orientation

by V. Kelly Bellis

Introduction

The purpose of this study initially began as a brief overview on how to orient drone panoramas to *true north*, and for more on that, see the separate article, *Panorama Orientation* wherein using solar azimuths or geodetic azimuths to other known positions visible in the panorama, is discussed using PTGui's Panorama Editor, Numerical transform for all types of panorama datasets, terrestrial and aerial.

The reason for this investigation stems largely from belabored discussions (in many an online forum¹) generally associated with DJI drones, and more in particular focused on using one of DJI-XMP tags; specifically, either GimbalYawDegree or FlightYawDegree, for the determination of drone panorama orientation. While such concerns are certainly warranted, they can be sidestepped entirely by orienting panoramas to known geodetic azimuths.

The results of this investigation are based upon only one drone, the [DJI Mavic Air 2](#) (MA2), dozens of panorama datasets, each dataset containing 26 images, all collected using the DJI Fly app's built-in programmed panorama routine.

In theory, when shooting panoramas the direction of the camera (gimbal yaw), and the direction of the airframe (flight yaw) should be nearly equal; i.e., their difference (Δ) should be ≈ 0 . However, this study has shown that Δ randomly varied between datasets, and ranged broadly; i.e., 8.6° to -25.5° , irrespective of locality, altitude, both before and after compass and IMU calibrations.

Because of these dubious Δ s, one of the drone panorama datasets (0958) was simultaneously photographed from directly beneath it using a stationary Canon 5DM3 DSLR. As the MA2 hovered overhead, situated 2.3 meters above the 5DM3, the 5DM3 was remotely triggered at as nearly as possible to the instant as the MA2 took its photos. The 5DM3 photos were then carefully analyzed and measured, demonstrating that the DJI-XMP tags were largely unrelated to the actual physical Δ between the airframe's yaw and the gimbal's yaw.

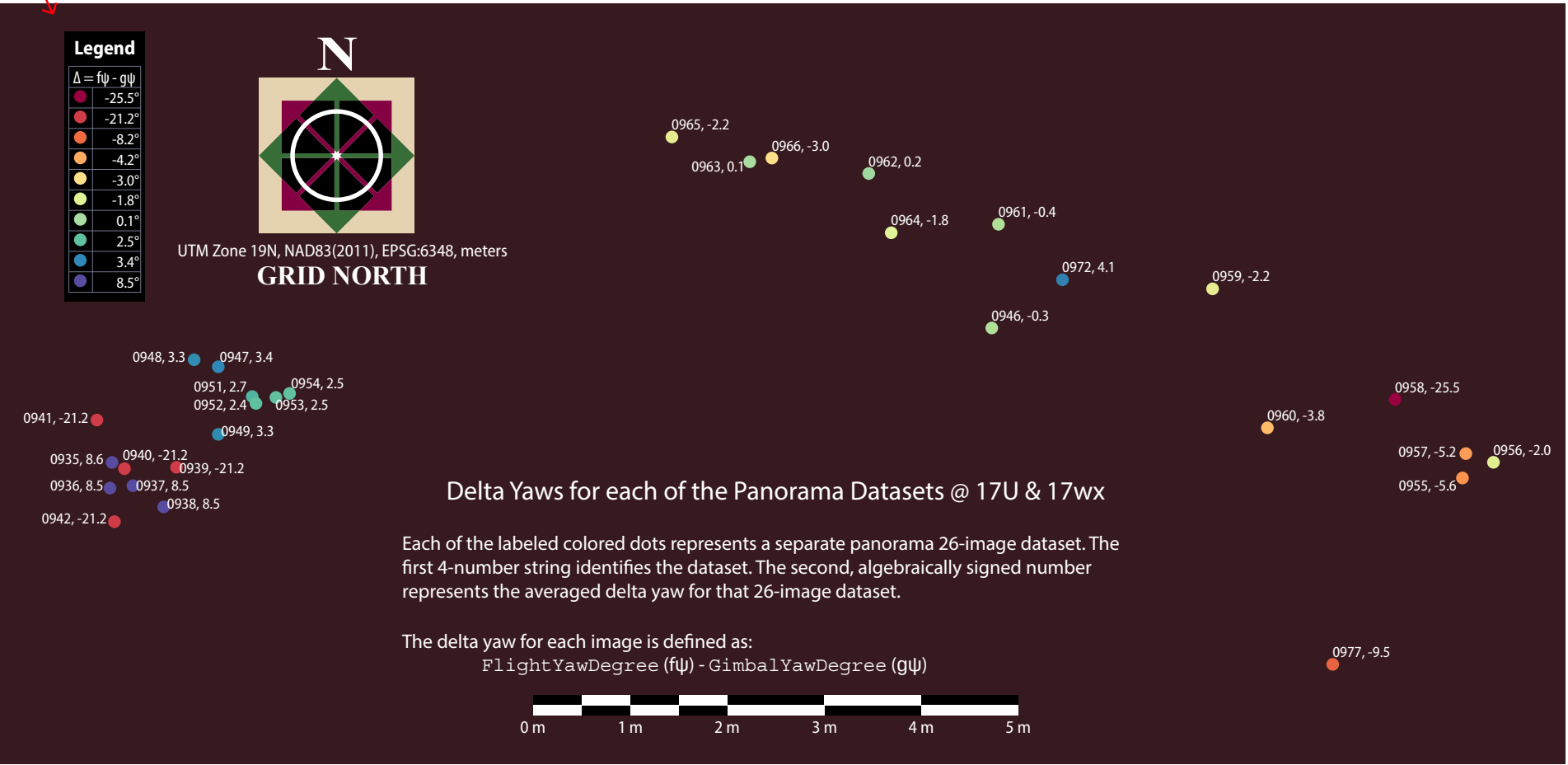
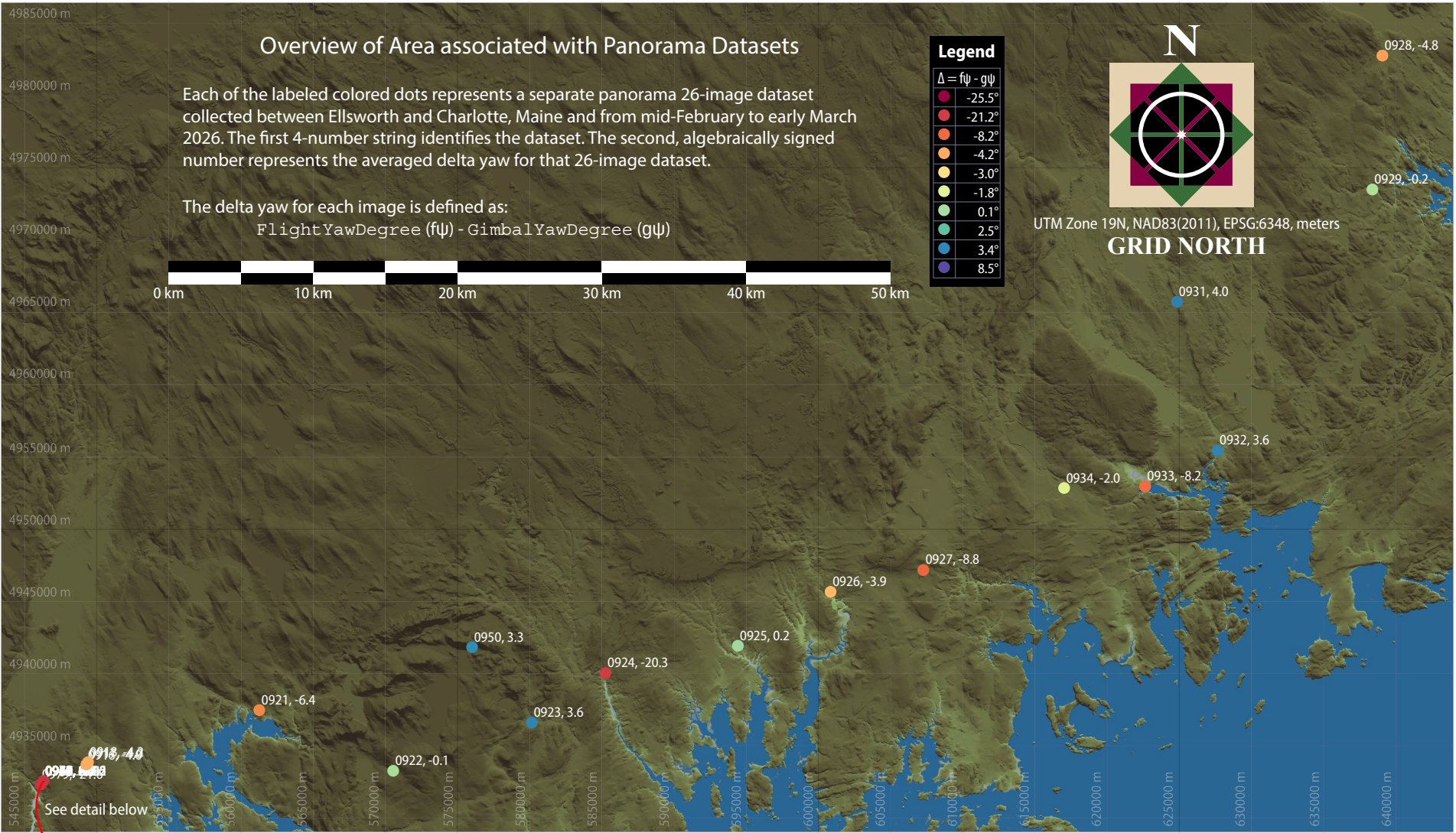
¹ For example, <https://github.com/OpenDroneMap/ODM/issues/1809> and <https://community.opendronemap.org/t/gimbalyaw-or-flightyaw/22307/3>

DJI's True North

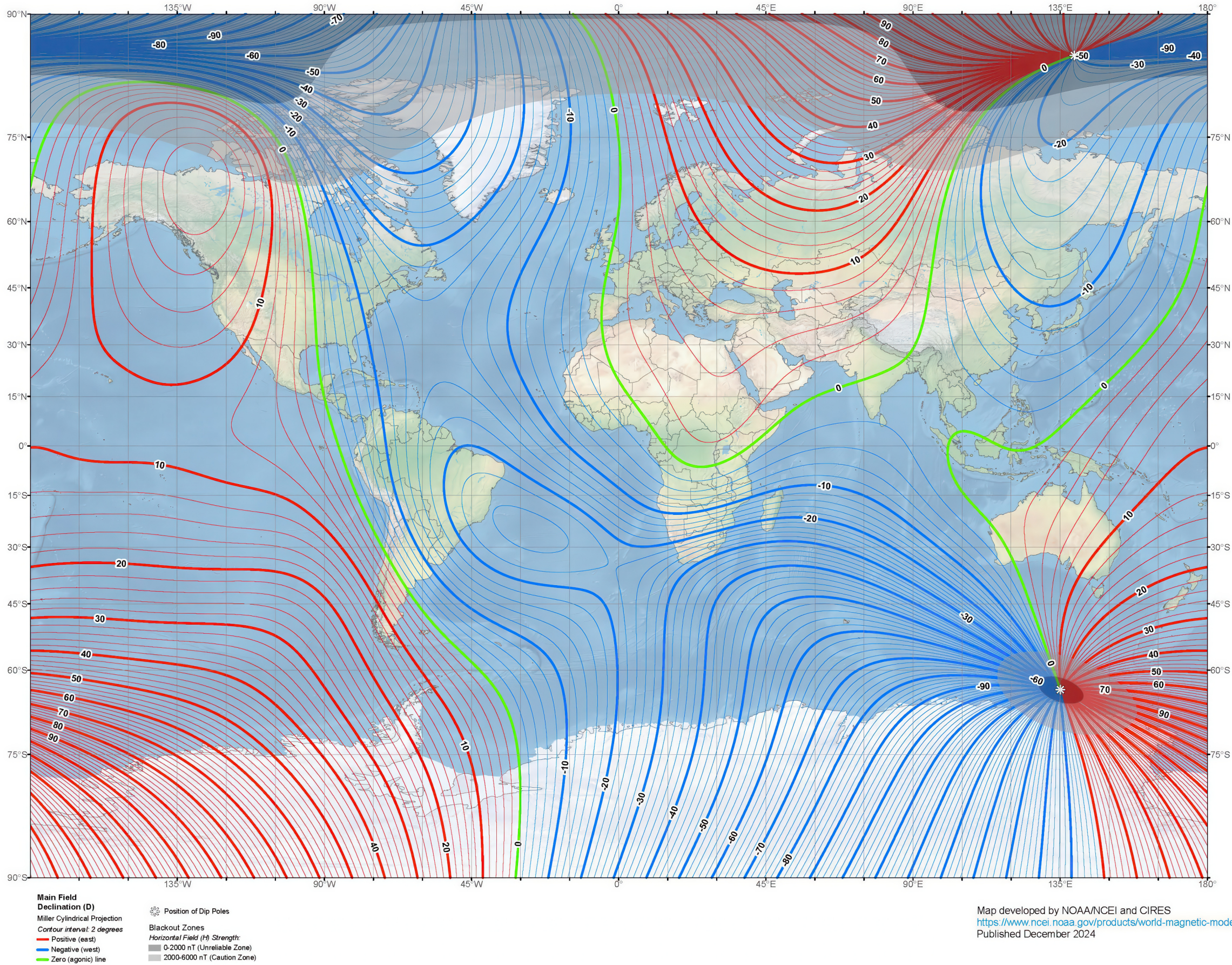
DJI's directional data is oriented to True North. For example, the values that are given for both of the DJI XMP tags that are recorded in each image's metadata; i.e., FlightYawDegree and GimbalYawDegree are relative to *True North*; however, note that there are qualifiers predicated on the aircraft's sensors; primarily *the magnetometer* (electronic compass), and the *accelerometer* (IMU, inertial measurement unit). This is why it's suggested to periodically perform calibration of both the compass and the IMU using the DJI Fly app for best results. Also, compass calibrations are generally suggested to be performed before flying in new geographic areas.

The fused IMU+magnetometer magnetic values of direction are then used internally with a *World Magnetic Model* (WMM) to derive and subsequently write the True North values in the metadata. The specific WMM that DJI uses in its app remains unknown, but a similar one is shown below, *US/UK World Magnetic Model - Epoch 2025.0, Main Field Declination (D)*. Note that the various colored isogonic contour lines shown on this chart appear static, but in reality they dynamically move around and their temporal nature is why the models are regularly updated; e.g., epoch 2020, 2025, etc.

The Earth's magnetic field isn't the only magnetic field that influences the compass. Even with a properly calibrated device; e.g., phone, drone, or other electronics, there are multiple other local influences that come readily into play. These include any Electromagnetic fields (EMFs) produced by ferrous materials above or beneath the ground, as well as overhead utility wires, solar activity tied to the time of day,



US/UK World Magnetic Model - Epoch 2025.0
Main Field Declination (D)



This image is provided courtesy of the National Centers for Environmental Information (NCEI) and available at: <https://www.ncei.noaa.gov/sites/default/files/inline-images/D>

space weather, etc. The compass needle was what my old friend, and surveyor, Harry Plummer, referred to as, a *wet noodle*.

$$\Delta = F\psi - G\psi$$

As mentioned earlier, in theory, the direction of the camera (gimbal yaw), and the direction of the airframe (flight yaw) should be nearly equal; i.e., their difference (Δ) should be ≈ 0 . As mapped out on both [Overview of Area associated with Panorama Datasets](#) and [Delta Yaws for each of the Panorama Datasets @ 17U & 17Wx](#), ≈ 0 is far from often the case.

Given these Δ s (FlightYawDegree - GimbalYawDegree), how close is PTGui orienting the panoramas to *True North*? To answer that question, first each panorama was stitched, stereographic projection down, exported, and then a measurement along an azimuth from its center to a known position was used to calculate the needed Numerical transform yaw: value. Those results are graphed out - see [DJI Mavic Air 2 Yaw Deltas, and PTGui Yaw Corrections Predicated on GimbalYawDegree and FlightGimbalDegree](#), with its tabular data shown directly beneath it.

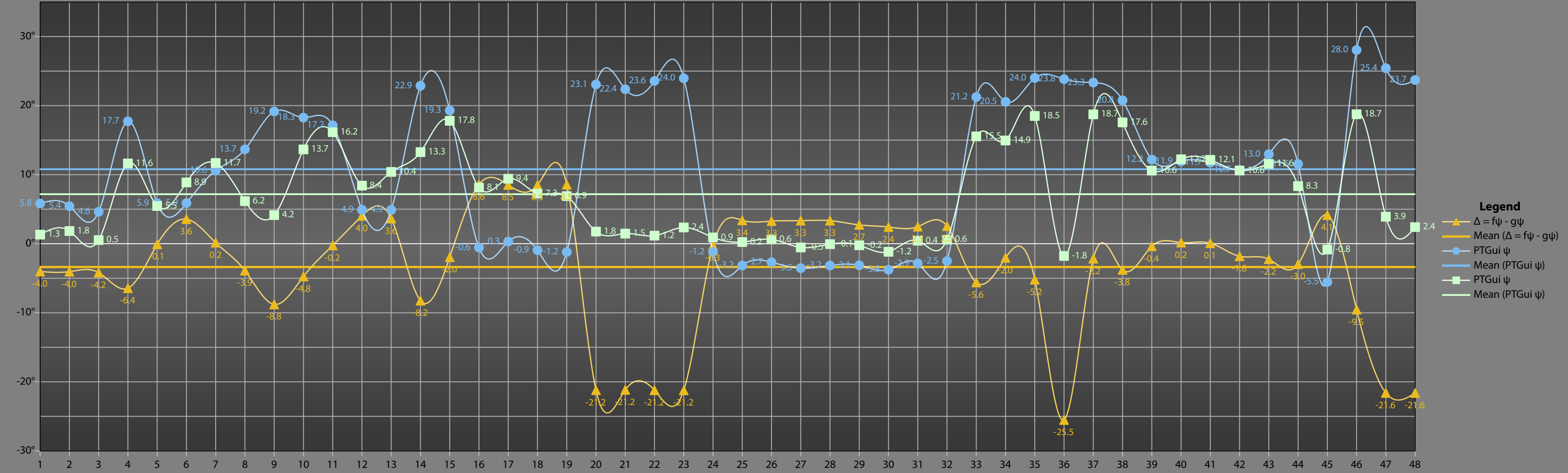
$$\Delta = F\psi_{5DM3} - G\psi_{5DM3}$$

DJI-XMP's meta tags and their theoretical difference ought being ≈ 0 notwithstanding, what is the observed physical direction of the camera (gimbal yaw), and the direction of the airframe (flight yaw)? To answer that question, dataset 0958 was photographed using the Canon 5DM3 DSLR camera from directly beneath the drone. Then the photos were carefully measured. The results of which are summarized in the table and graph [5DM3 \$\Delta\$ Measurements Associated with Dataset 0958](#).

PTGui Yaw Corrections

Currently, PTGui v13.7 uses the GimbalYawDegree value to determine panorama orientation. In order to orient the panoramas to true north, the blue-highlighted values (shown below) were applied in PTGui's Numerical Yaw correction.

DJI Mavic Air 2 Yaw Deltas, and PTGui Yaw Corrections Predicated on GimbalYawDegree and FlightGimbalDegree



DJI Mavic Air 2 Datasets - WGS84, meters

PTGui Yaw Corrections for Gimbal (Pre-swapped) & Flight (Post-swapped) Predicates									Pre-swapped			Post-swapped		
Index	Dataset	RefAz	to	SolAz	DateTime	GPSLatitude	GPSLongitude	$\Delta = f\psi - g\psi$	PSD $\angle$	PTGuiAz	PTGui ψ	PSD $\angle$	PTGuiAz	PTGui ψ
1	0916			196.08	2026-02:17 12:42:52	44.55430677	-68.37987103	-4.0	-111.9	201.9	5.82	-107.4	197.4	1.32
2	0917			196.46	2026-02:17 12:44:11	44.55515967	-68.37888404	-4.0	-111.9	201.9	5.44	-108.3	198.3	1.84
3	0918			196.87	2026-02:17 12:45:38	44.55638422	-68.37825444	-4.2	-111.5	201.5	4.63	-107.4	197.4	0.53
4	0921			114.37	2026-02:18 07:18:07	44.58785530	-68.22806527	-6.4	-42.1	132.1	17.73	-36.0	126.0	11.63
5	0922			120.24	2026-02:18 07:48:38	44.54901265	-68.11188532	-0.1	-36.1	126.1	5.86	-35.7	125.7	5.46
6	0923			129.62	2026-02:18 08:34:00	44.57833478	-67.99056328	3.6	-45.5	135.5	5.88	-48.5	138.5	8.88
7	0925			145.31	2026-02:18 09:40:46	44.62438925	-67.80971475	0.2	-65.9	155.9	10.59	-67.0	157.0	11.69
8	0926			154.73	2026-02:18 10:16:33	44.65719920	-67.72796274	-3.9	-78.4	168.4	13.67	-70.9	160.9	6.17
9	0927			161.45	2026-02:18 10:40:34	44.67000817	-67.64649946	-8.8	-90.6	180.6	19.15	-75.6	165.6	4.15
10	0928			157.54	2026-02:19 10:24:57	44.98526809	-67.23557863	-4.8	-85.8	175.8	18.26	-81.2	171.2	13.66
11	0929			166.35	2026-02:19 10:56:14	44.90180218	-67.24704487	-0.2	-93.5	183.5	17.15	-92.5	182.5	16.15
12	0931			184.99	2026-02:19 12:00:21	44.83452071	-67.42045599	4.0	-99.9	189.9	4.91	-103.4	193.4	8.41
13	0932			192.70	2026-02:19 12:26:30	44.74108531	-67.38742045	3.6	-107.6	197.6	4.90	-113.1	203.1	10.40
14	0933			198.13	2026-02:19 12:45:40	44.71960799	-67.45131145	-8.2	-131.0	221.0	22.87	-121.4	211.4	13.27
15	0934			203.90	2026-02:19 13:06:38	44.71942226	-67.52220692	-2.0	-133.2	223.2	19.30	-131.7	221.7	17.80
16	0935			166.87	2026-02:22 11:03:17	44.54454943	-68.41720970	8.6	-76.3	166.3	-0.57	-85.0	175.0	8.13
17	0936			167.39	2026-02:22 11:05:04	44.54454706	-68.41720999	8.5	-77.7	167.7	0.31	-86.8	176.8	9.41
18	0937			167.94	2026-02:22 11:06:55	44.54454727	-68.41720702	8.5	-77.0	167.0	-0.94	-85.2	175.2	7.26
19	0938			168.41	2026-02:22 11:08:30	44.54454528	-68.41720305	8.5	-77.2	167.2	-1.21	-85.3	175.3	6.89
20	0939			180.34	2026-02:22 11:48:14	44.54454894	-68.41720136	-21.2	-113.4	203.4	23.06	-92.1	182.1	1.76
21	0940			180.73	2026-02:22 11:49:32	44.54454885	-68.41720809	-21.2	-113.1	203.1	22.37	-92.2	182.2	1.47
22	0941			181.03	2026-02:22 11:50:32	44.54455337	-68.41721162	-21.2	-114.6	204.6	23.57	-92.2	182.2	1.17
23	0942			181.74	2026-02:22 11:52:52	44.54454395	-68.41720944	-21.2	-115.7	205.7	23.96	-94.1	184.1	2.36
24	0946			256.09	2026-02:24 17:04:42	44.54456129	-68.41709561	-0.3	-164.9	254.9	-1.19	-167.0	257.0	0.91
25	0947	239.36	8Uchim		2026-02:26 11:37:20	44.54455822	-68.41719587	3.4	-146.2	236.2	-3.16	-149.6	239.6	0.24
26	0948	256.98	WRMU900		2026-02:26 11:38:34	44.54455889	-68.41719897	3.3	-164.3	254.3	-2.68	-167.6	257.6	0.62

DJI Mavic Air 2 Datasets - WGS84, meters

PTGui Yaw Corrections for Gimbal (Pre-swapped) & Flight (Post-swapped) Predicates								Pre-swapped			Post-swapped			
Index	Dataset	RefAz	to	SolAz	DateTime	GPSLatitude	GPSLongitude	$\Delta = f\psi - g\psi$	PSD $\angle$	PTGuiAz	PTGui ψ	PSD $\angle$	PTGuiAz	PTGui ψ
27	0949			177.94	2026-02-26 11:39:51	44.54455196	-68.41719591	3.3	-84.4	174.4	-3.54	-87.4	177.4	-0.54
28	0950			178.46	2026-02-26 11:41:32	44.62638018	-68.04653241	3.3	-85.3	175.3	-3.16	-88.4	178.4	-0.06
29	0951	257.01	WRMU900	178.83	2026-02-26 11:42:43	44.54455543	-68.41719148	2.7	-85.7	175.7	-3.13	-88.6	178.6	-0.23
30	0952			179.57	2026-02-26 11:45:07	44.54455480	-68.41719100	2.4	-85.8	175.8	-3.77	-88.4	178.4	-1.17
31	0953	256.96	WRMU900		2026-02-26 11:46:42	44.54455534	-68.41718841	2.5	-164.1	254.1	-2.86	-167.4	257.4	0.44
32	0954	257.01	WRMU900		2026-02-26 11:48:08	44.54455570	-68.41718663	2.5	-164.5	254.5	-2.51	-167.6	257.6	0.59
33	0955	245.06	8Uchim		2026-02-28 07:37:28	44.54454707	-68.41703478	-5.6	-176.3	266.3	21.24	-170.6	260.6	15.54
34	0956	245.05	8Uchim		2026-02-28 07:38:55	44.54454851	-68.41703075	-2.0	-175.6	265.6	20.55	-170.0	260.0	14.95
35	0957	244.90	8Uchim		2026-02-28 07:49:07	44.54454933	-68.41703432	-5.2	-178.9	268.9	24.00	-173.4	263.4	18.50
36	0958	244.28	8Uchim	127.76	2026-02-28 08:35:59	44.54455440	-68.41704342	-25.5	-178.1	268.1	23.82	-152.5	242.5	-1.78
37	0959	257.06	WRMU900		2026-03-03 05:51:29	44.54456476	-68.41706697	-2.2	169.6	280.4	23.34	174.2	275.8	18.74
38	0960	257.13	WRMU900		2026-03-03 05:56:08	44.54455185	-68.41706000	-3.8	172.1	277.9	20.77	175.3	274.7	17.57
39	0961	257.01	WRMU900		2026-03-03 06:11:03	44.54457088	-68.41709464	-0.4	-179.2	269.2	12.19	-177.6	267.6	10.59
40	0962	256.97	WRMU900		2026-03-03 06:12:17	44.54457567	-68.41711140	0.2	-178.9	268.9	11.93	-179.2	269.2	12.23
41	0963	256.95	WRMU900		2026-03-03 06:13:35	44.54457684	-68.41712681	0.1	-178.7	268.7	11.75	-179.1	269.1	12.15
42	0964	257.00	WRMU900		2026-03-03 06:14:44	44.54457017	-68.41710855	-1.8	-177.7	267.7	10.70	-177.6	267.6	10.60
43	0965	256.93	WRMU900		2026-03-03 06:15:49	44.54457919	-68.41713687	-2.2	-179.9	269.9	12.97	-178.5	268.5	11.57
44	0966	256.96	WRMU900		2026-03-03 06:16:46	44.54457717	-68.41712394	-3.0	-178.5	268.5	11.54	-175.3	265.3	8.34
45	0972	257.04	WRMU900	106.61	2026-03-04 06:53:42	44.54456570	-68.41708641	4.1	-161.5	251.5	-5.54	-166.2	256.2	-0.84
46	0977	257.25	WRMU900	119.20	2026-03-04 07:59:23	44.54452990	-68.41705175	-9.5	164.7	285.3	28.05	174.0	276.0	18.75
47	0978	255.49	WRMU900	119.49	2026-03-04 08:00:46	44.54479717	-68.41753192	-21.6	169.1	280.9	25.41	-169.4	259.4	3.91
48	0979	265.39	WRMU900	119.84	2026-03-04 08:02:30	44.54276523	-68.42003950	-21.6	160.9	289.1	23.71	-177.8	267.8	2.41
AVERAGE								-3.39			10.77			7.16
STDEV								8.90			10.56			6.42

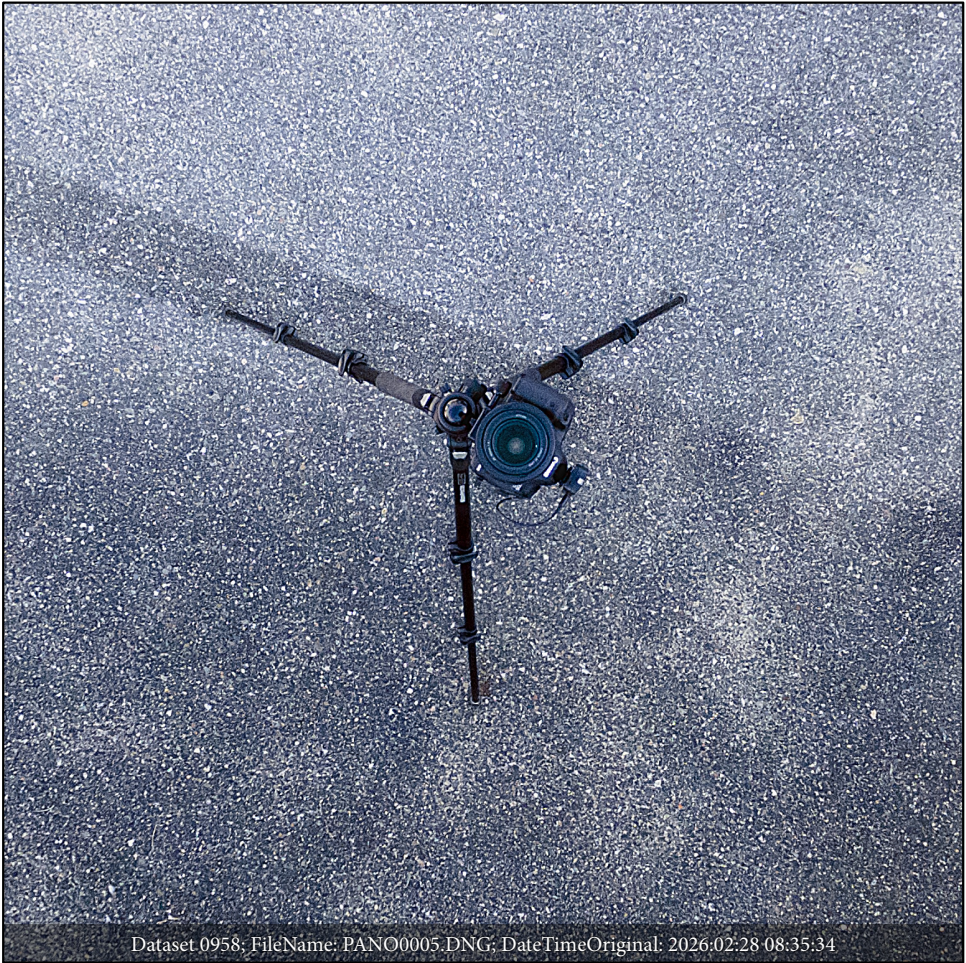
Duplicate datasets were then edited by interchanging flight and gimbal yaw values in order to determine the needed green-highlighted values to apply in PTGui's Numerical Yaw correction to orient panoramas to true north based the FlightYawDegree. While this appears to offer some improvement; i.e., going from an average correction of 10.77° down to 7.16° over the 48 datasets, or looking at dataset 0958 in particular, it is still far from approaching the average 0.4° measured from the 5DM3 photos (see page 6).

The DJI yaw data remains questionable for consistently and reliably orienting drone panoramas to true north and suggests the need for additional testing across multiple air frames.



Panorama 0958 after the 24.3° yaw correction in PTGui

$$\Delta = F\psi_{5DM3} - G\psi_{5DM3}$$



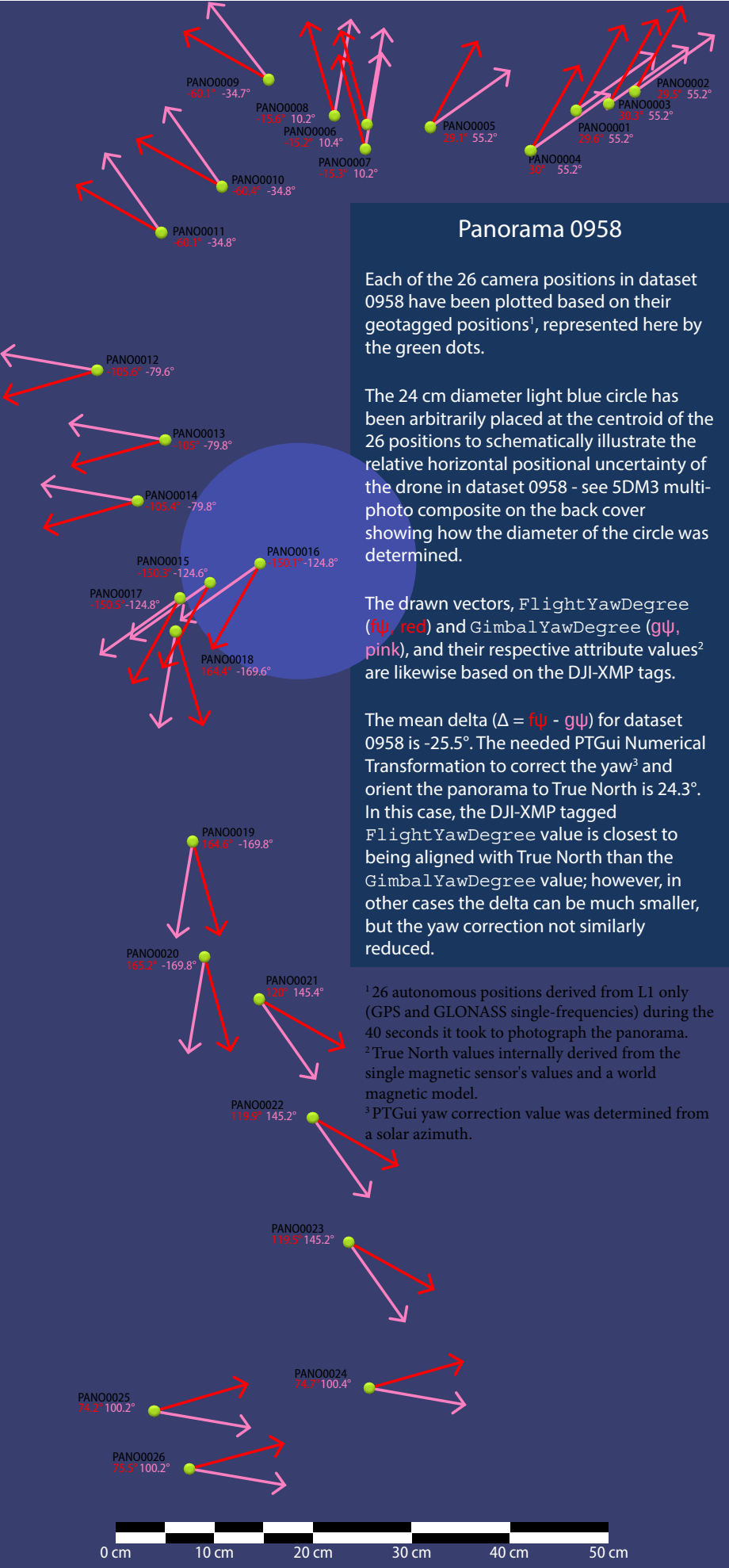
Dataset 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

About these diagrams

The following set of diagrams relate to the images captured by DJI Mavic Air 2 (MA2) (2026:02:28 08:35:27 through 2026:02:28 08:36:07) comprising the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for FlightYawDegree and GimbalYawDegree.

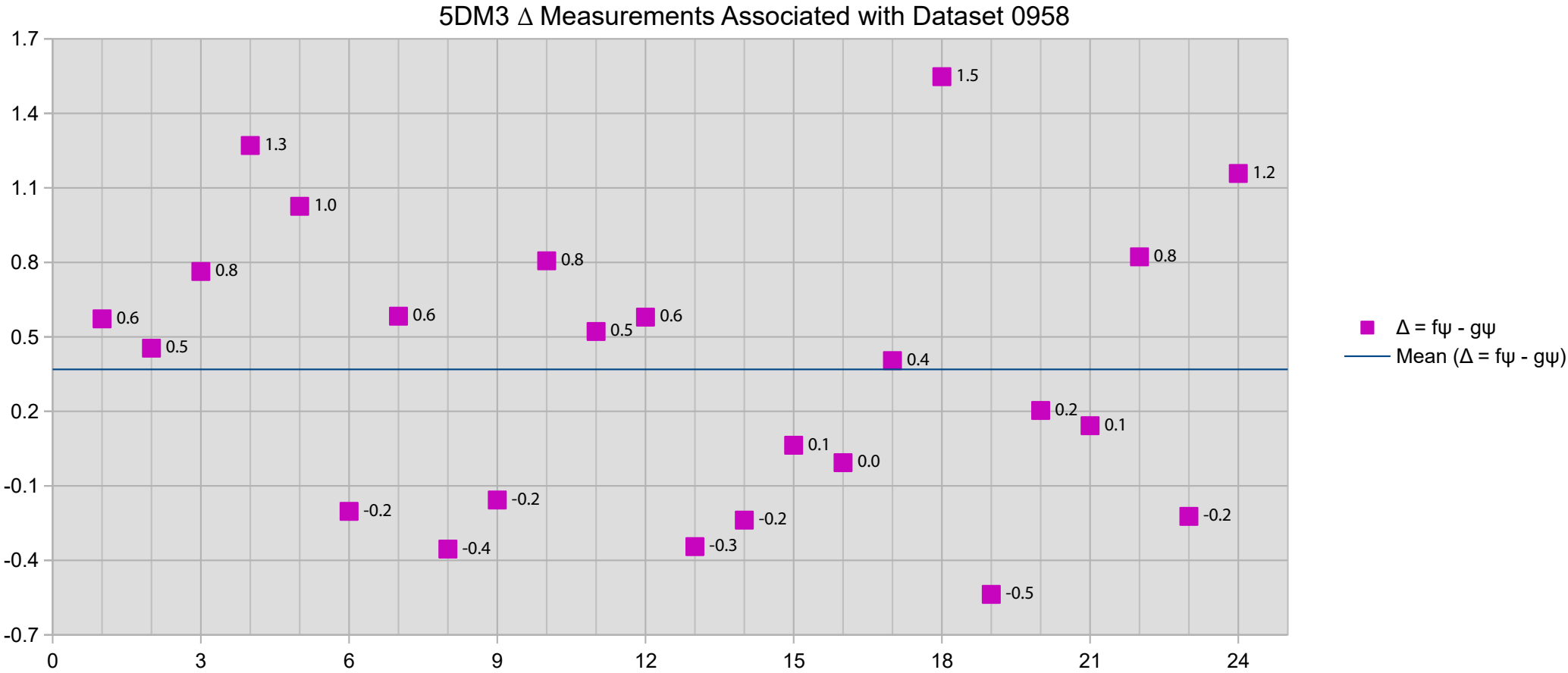
The images of the drone while hovering during the the default panorama shooting sequence, were captured by the Canon 5D Mark III (5DM3).



DJI-Mavic Air 2 Dataset 0958 - WGS84, meters												
FileName	DateTimeOriginal	GPSLatitude	GPSLongitude	Alt	gφ	fφ	gθ	fθ	gψ	fψ	Δ = fψ - gψ	
PANO0001	2026:02:28 08:35:27	44.544558472	-68.417039806	3.5	0.0	1.4	-0.2	-1.1	55.2	29.6	-25.6	
PANO0002	2026:02:28 08:35:29	44.544558639	-68.417039056	3.5	0.0	-0.2	-19.8	0.2	55.2	29.5	-25.7	
PANO0003	2026:02:28 08:35:30	44.544558528	-68.417039389	3.5	0.0	1.6	15.0	1.5	55.2	30.3	-24.9	
PANO0004	2026:02:28 08:35:32	44.544558111	-68.417040389	3.5	0.0	-0.8	-54.8	1.5	55.2	30.0	-25.2	
PANO0005	2026:02:28 08:35:34	44.544558639	-68.417042167	3.5	0.0	1.6	-89.8	1.8	55.2	29.1	-26.1	
PANO0006	2026:02:28 08:35:36	44.544558361	-68.417042472	3.5	0.0	-0.7	-55.0	1.2	10.4	-15.2	-25.6	
PANO0007	2026:02:28 08:35:37	44.544558139	-68.417042500	3.5	0.0	0.7	-20.2	0.3	10.2	-15.3	-25.5	
PANO0008	2026:02:28 08:35:39	44.544558444	-68.417042889	3.5	0.0	-0.2	14.8	0.1	10.2	-15.6	-25.8	
PANO0009	2026:02:28 08:35:40	44.544558778	-68.417043722	3.5	0.0	0.0	15.0	0.6	-34.7	-60.1	-25.4	
PANO0010	2026:02:28 08:35:42	44.544557806	-68.417044333	3.5	0.0	0.3	-19.8	-0.2	-34.8	-60.4	-25.6	
PANO0011	2026:02:28 08:35:43	44.544557389	-68.417045111	3.5	0.0	-0.8	-54.8	-0.4	-34.8	-60.1	-25.3	
PANO0012	2026:02:28 08:35:45	44.544556139	-68.417045944	3.5	0.0	-0.5	-55.0	-1.1	-79.6	-105.6	-26.0	
PANO0013	2026:02:28 08:35:46	44.544555500	-68.417045083	3.5	0.0	1.3	-20.2	-1.5	-79.8	-105.0	-25.2	
PANO0014	2026:02:28 08:35:48	44.544554944	-68.417045444	3.5	0.0	-1.0	14.8	-0.9	-79.8	-105.4	-25.6	
PANO0015	2026:02:28 08:35:49	44.544554194	-68.417044528	3.5	0.0	0.9	15.0	-1.1	-124.6	-150.3	-25.7	
PANO0016	2026:02:28 08:35:51	44.544554361	-68.417043889	3.5	0.0	1.4	-19.8	-1.0	-124.8	-150.1	-25.3	
PANO0017	2026:02:28 08:35:52	44.544554056	-68.417044917	3.5	0.0	0.9	-54.8	-0.6	-124.8	-150.5	-25.7	
PANO0018	2026:02:28 08:35:54	44.544553750	-68.417044972	3.5	0.0	0.4	-55.0	0.0	-169.6	164.4	-26.0	
PANO0019	2026:02:28 08:35:56	44.544551833	-68.417044778	3.5	0.0	0.2	-20.2	0.3	-169.8	164.6	-25.6	
PANO0020	2026:02:28 08:35:57	44.544550778	-68.417044639	3.5	0.0	0.3	14.8	0.9	-169.8	165.2	-25.0	
PANO0021	2026:02:28 08:35:59	44.544550389	-68.417043944	3.5	0.0	0.3	15.0	2.5	145.4	120.0	-25.4	
PANO0022	2026:02:28 08:36:00	44.544549306	-68.417043278	3.5	0.0	-0.1	-19.8	2.4	145.2	119.9	-25.3	
PANO0023	2026:02:28 08:36:01	44.544548167	-68.417042833	3.5	0.0	0.6	-54.8	2.0	145.2	119.5	-25.7	
PANO0024	2026:02:28 08:36:03	44.544546833	-68.417042583	3.5	0.0	-0.2	-55.0	0.7	100.4	74.7	-25.7	
PANO0025	2026:02:28 08:36:06	44.544546639	-68.417045333	3.5	0.0	1.3	-20.0	1.6	100.2	74.2	-26.0	
PANO0026	2026:02:28 08:36:07	44.544546111	-68.417044889	3.5	0.0	1.0	14.8	1.1	100.2	75.5	-24.7	
Averaged		44.544554396	-68.417043419								-25.5	

5DM3 Δ Measurements Associated with Dataset 0958

FileName	DateTimeOriginal	airframe y axis	Δ = fψ - gψ	gimbal x axis
_5D32631.tif	2026:02:28 08:35:32	-29.02	0.6	60.41
_5D32632.tif	2026:02:28 08:35:33	-29.00	0.5	60.54
_5D32633.tif	2026:02:28 08:35:36	-29.76	0.8	59.48
_5D32634.tif	2026:02:28 08:35:37	-40.67	1.3	48.06
_5D32635.tif	2026:02:28 08:35:39	-74.51	1.0	14.46
_5D32636.tif	2026:02:28 08:35:40	-75.09	-0.2	15.11
_5D32637.tif	2026:02:28 08:35:42	-84.06	0.6	5.36
_5D32638.tif	2026:02:28 08:35:43	-119.76	-0.4	-29.41
_5D32639.tif	2026:02:28 08:35:45	-119.77	-0.2	-29.62
_5D32640.tif	2026:02:28 08:35:46	-122.91	0.8	-33.72
_5D32641.tif	2026:02:28 08:35:50	-164.50	0.5	-75.02
_5D32642.tif	2026:02:28 08:35:51	-168.64	0.6	-79.22
_5D32643.tif	2026:02:28 08:35:53	150.11	-0.3	-119.55
_5D32644.tif	2026:02:28 08:35:54	150.32	-0.2	-119.44
_5D32645.tif	2026:02:28 08:35:56	149.90	0.1	-120.16
_5D32646.tif	2026:02:28 08:35:57	105.24	0.0	-164.76
_5D32647.tif	2026:02:28 08:35:59	105.59	0.4	-164.82
_5D32648.tif	2026:02:28 08:36:00	103.52	1.5	-168.03
_5D32649.tif	2026:02:28 08:36:02	60.00	-0.5	-29.47
_5D32650.tif	2026:02:28 08:36:03	60.77	0.2	-29.43
_5D32651.tif	2026:02:28 08:36:05	60.30	0.1	-29.84
_5D32652.tif	2026:02:28 08:36:06	15.44	0.8	-75.38
_5D32653.tif	2026:02:28 08:36:08	14.92	-0.2	-74.86
_5D32655.tif	2026:02:28 08:36:11	16.53	1.2	-74.62
		Average	0.4	
		STDEV	0.6	





Scaled measurements closely related to

PANO0002.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 2 = airframe y axis - ((90 - gimbal x axis)*-1)

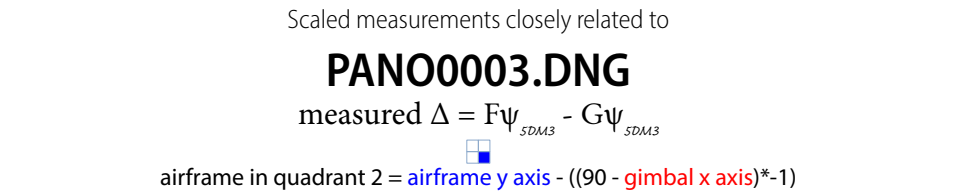
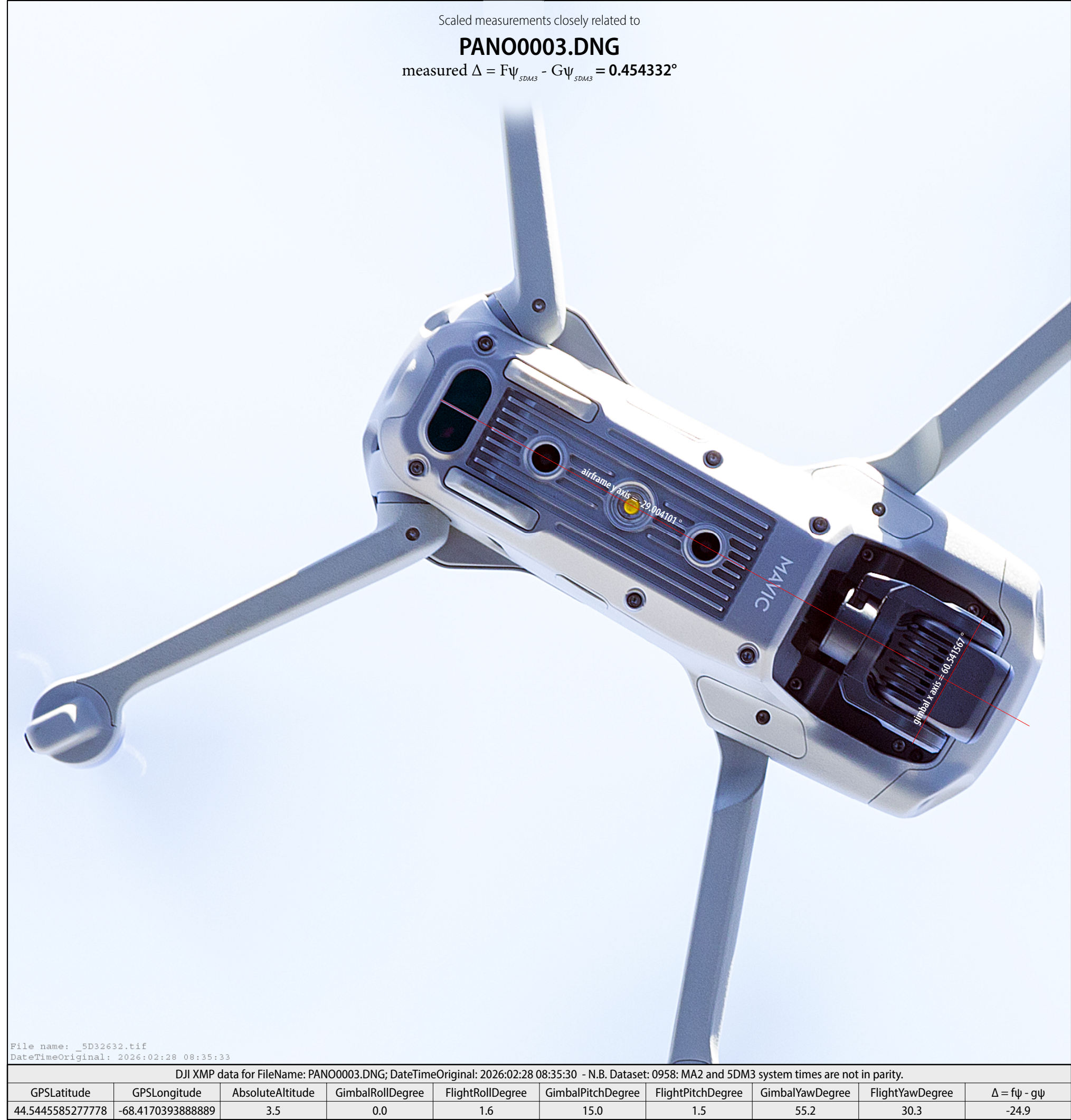
About these measurements

The image to the left [_5D32631.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0002.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.572686°, and not -25.7° as indicated in the DJI XMP's metadata.



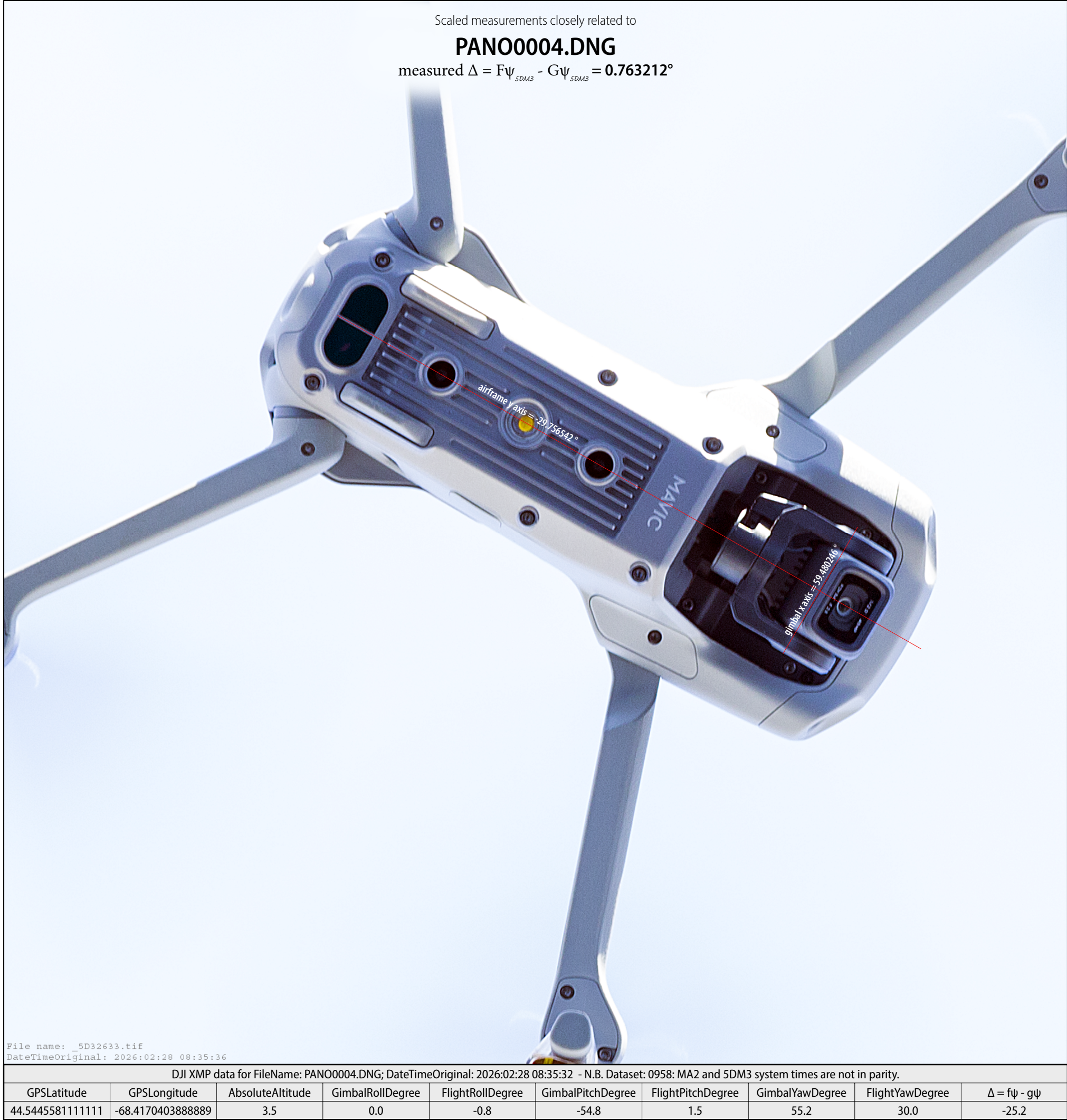
About these measurements

The image to the left [_5D32632.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0003.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.454332°, and not -24.9° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0004.DNG

measured $\Delta = F\psi_{5DM3} - G\psi_{5DM3}$

airframe in quadrant 2 = $\text{airframe y axis} - ((90 - \text{gimbal x axis}) * -1)$

About these measurements

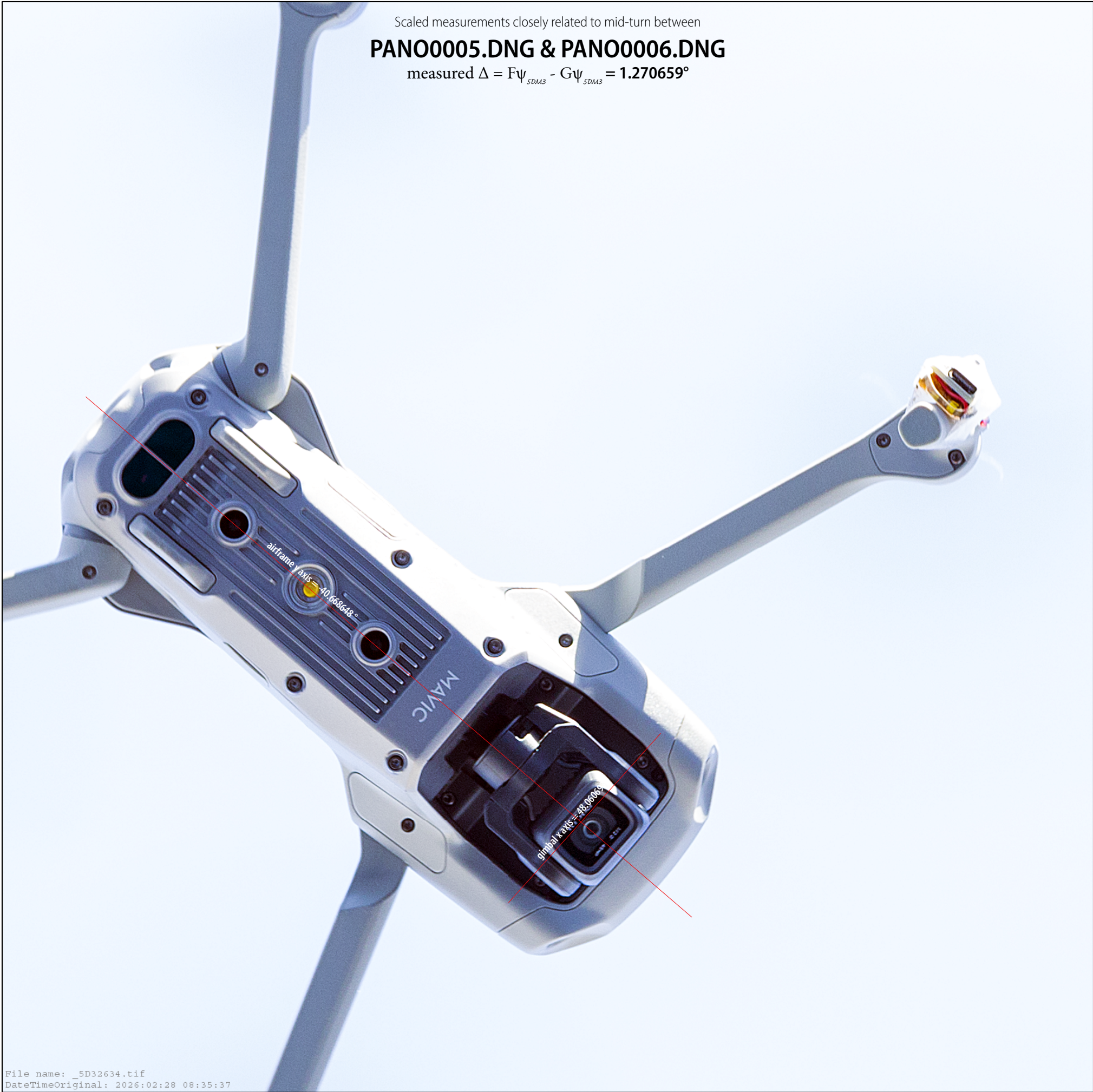
The image to the left [_5D32633.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0004.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

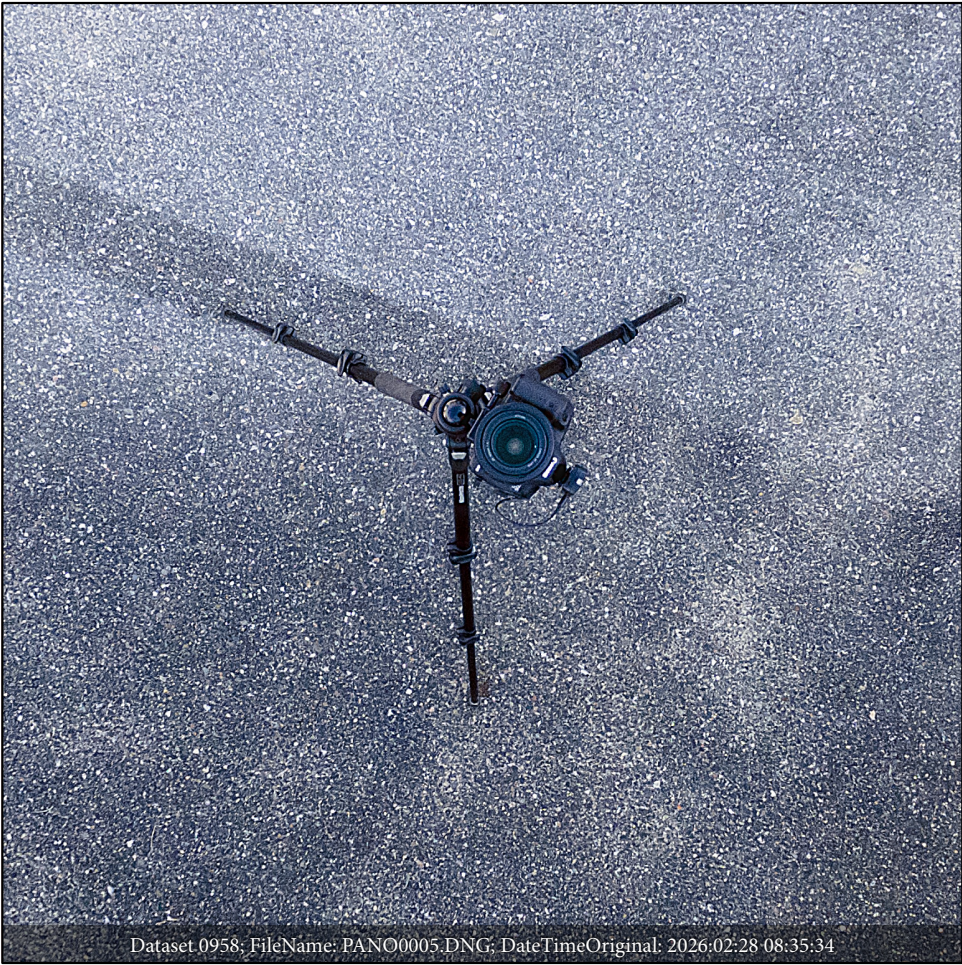
The difference from the airframe's yaw and the gimbal's yaw is 0.763212°, and not -25.2° as indicated in the DJI XMP's metadata.

Scaled measurements closely related to mid-turn between
PANO0005.DNG & PANO0006.DNG
measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3} = 1.270659^\circ$



File name: _5D32634.tif
DateTimeOriginal: 2026:02:28 08:35:37

DJI XMP data for FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34 - N.B. Dataset: 0958: MA2 and 5DM3 system times are not in parity.									
GPSLatitude	GPSLongitude	AbsoluteAltitude	GimbalRollDegree	FlightRollDegree	GimbalPitchDegree	FlightPitchDegree	GimbalYawDegree	FlightYawDegree	$\Delta = f\psi - g\psi$
44.5445586388889	-68.4170421666667	3.5	0.0	1.6	-89.8	1.8	55.2	29.1	-26.1



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to mid-turn between
PANO0005.DNG & PANO0006.DNG
measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 2 = $\text{airframe y axis} - ((90 - \text{gimbal x axis}) * -1)$

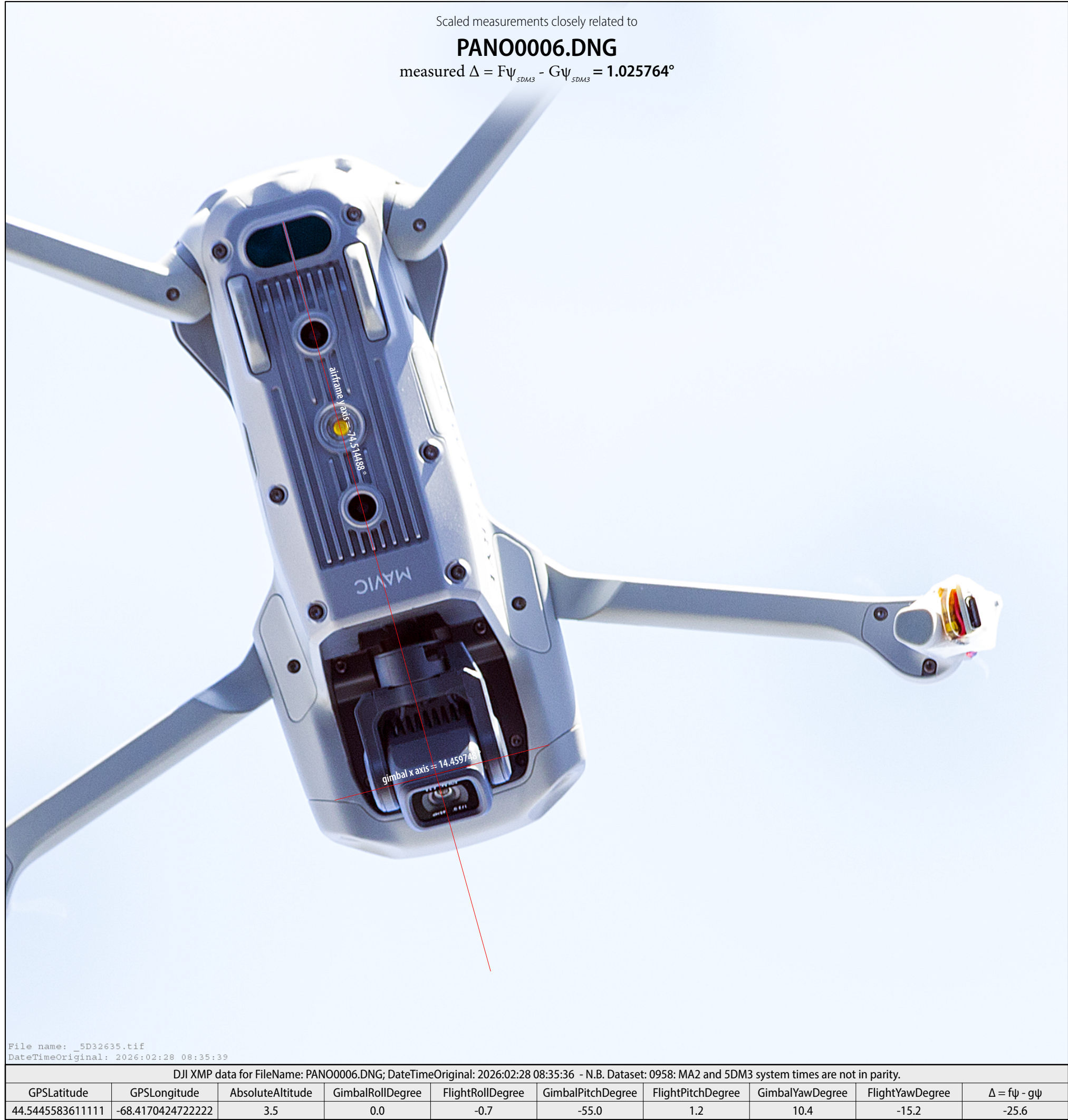
About these measurements

The image to the left [_5D32634.tif] was photographed using the Canon 5D Mark 3 (5DM3) and shot while the DJI Mavic Air 2 (MA2) was in mid-turn after [PANO0005.DNG] and before [PANO0006.DNG].

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 1.270659°, and not -26.1° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0006.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 2 = airframe y axis - ((90 - gimbal x axis)*-1)

About these measurements

The image to the left [_5D32635.tif] was photographed using the Canon 5D Mark 3 (5DM3) as the gimbal pitched up on the DJI Mavic Air 2 (MA2) after it shot the photograph [PANO0006.DNG] and before [PANO0007.DNG].

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

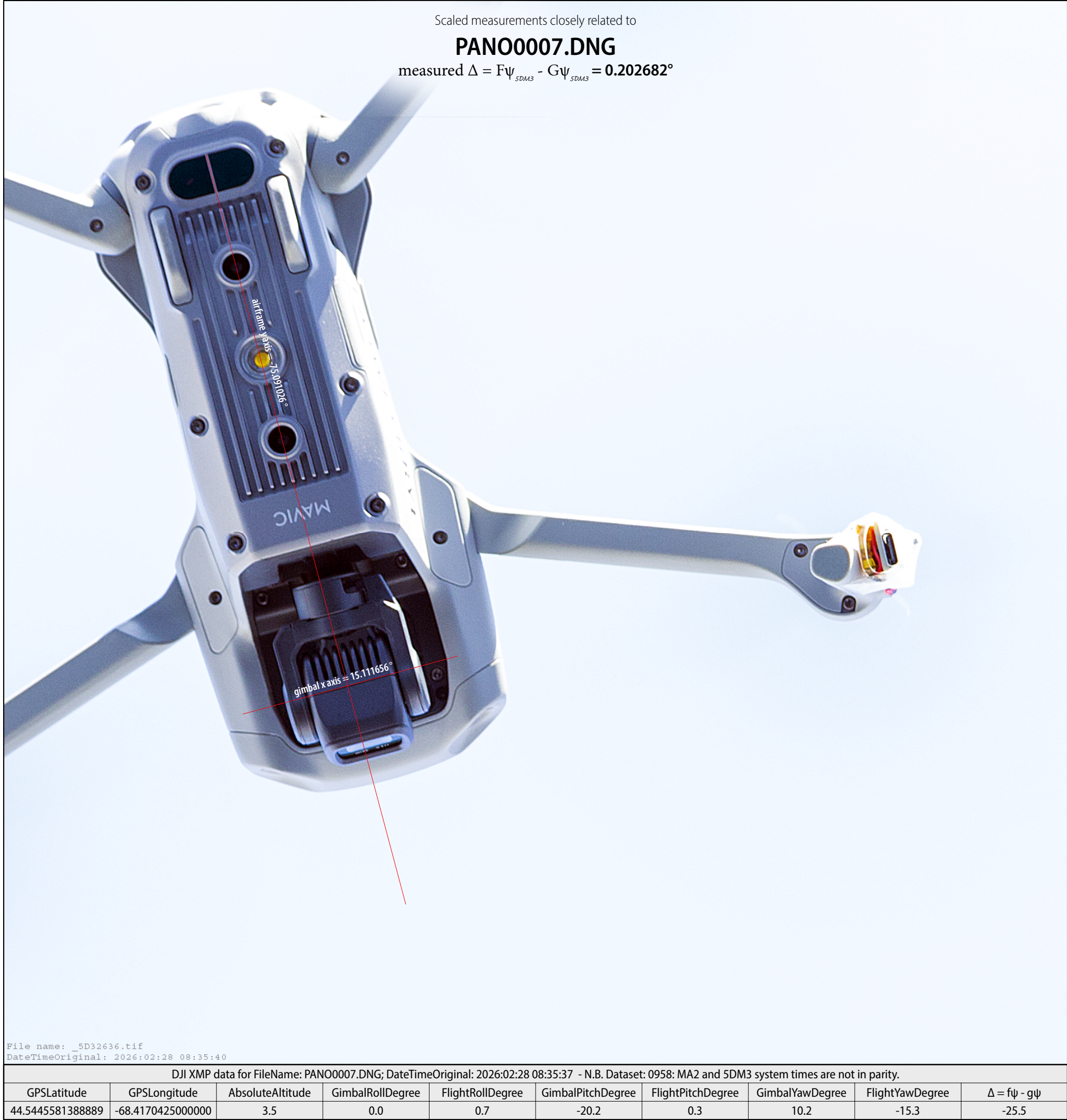
The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 1.025764°, and not -25.6° as indicated in the DJI XMP's metadata.

Scaled measurements closely related to

PANO0007.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3} = 0.202682^\circ$



File name: _5D32636.tif
DateTimeOriginal: 2026:02:28 08:35:40

DJI XMP data for FileName: PANO0007.DNG; DateTimeOriginal: 2026:02:28 08:35:37 - N.B. Dataset: 0958: MA2 and 5DM3 system times are not in parity.

GPSLatitude	GPSLongitude	AbsoluteAltitude	GimbalRollDegree	FlightRollDegree	GimbalPitchDegree	FlightPitchDegree	GimbalYawDegree	FlightYawDegree	$\Delta = f\psi - g\psi$
44.5445581388889	-68.4170425000000	3.5	0.0	0.7	-20.2	0.3	10.2	-15.3	-25.5



Scaled measurements closely related to

PANO0007.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

 airframe in quadrant 2 = $\text{airframe y axis} - ((90 - \text{gimbal x axis}) * -1)$

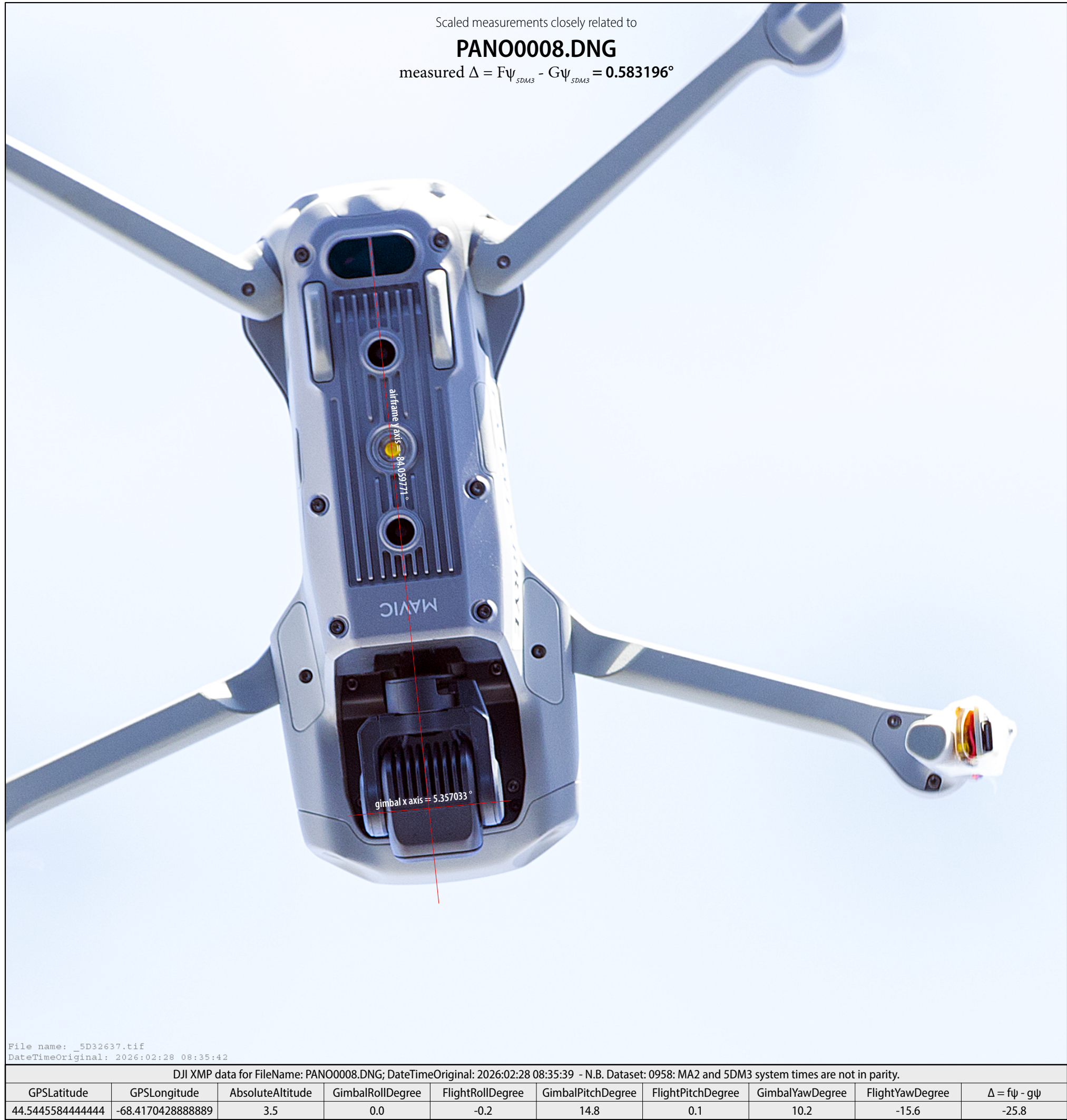
About these measurements

The image to the left [_5D32636.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0007.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.202682°, and not -25.5° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0008.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

 airframe in quadrant 2 =

airframe y axis - ((90 - gimbal x axis)*-1)

About these measurements

The image to the left [_5D32637.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0008.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.583196°, and not -25.8° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0009.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 3 = $\text{airframe y axis} - ((\text{ABS}(\text{gimbal x axis}) + 90) * -1)$

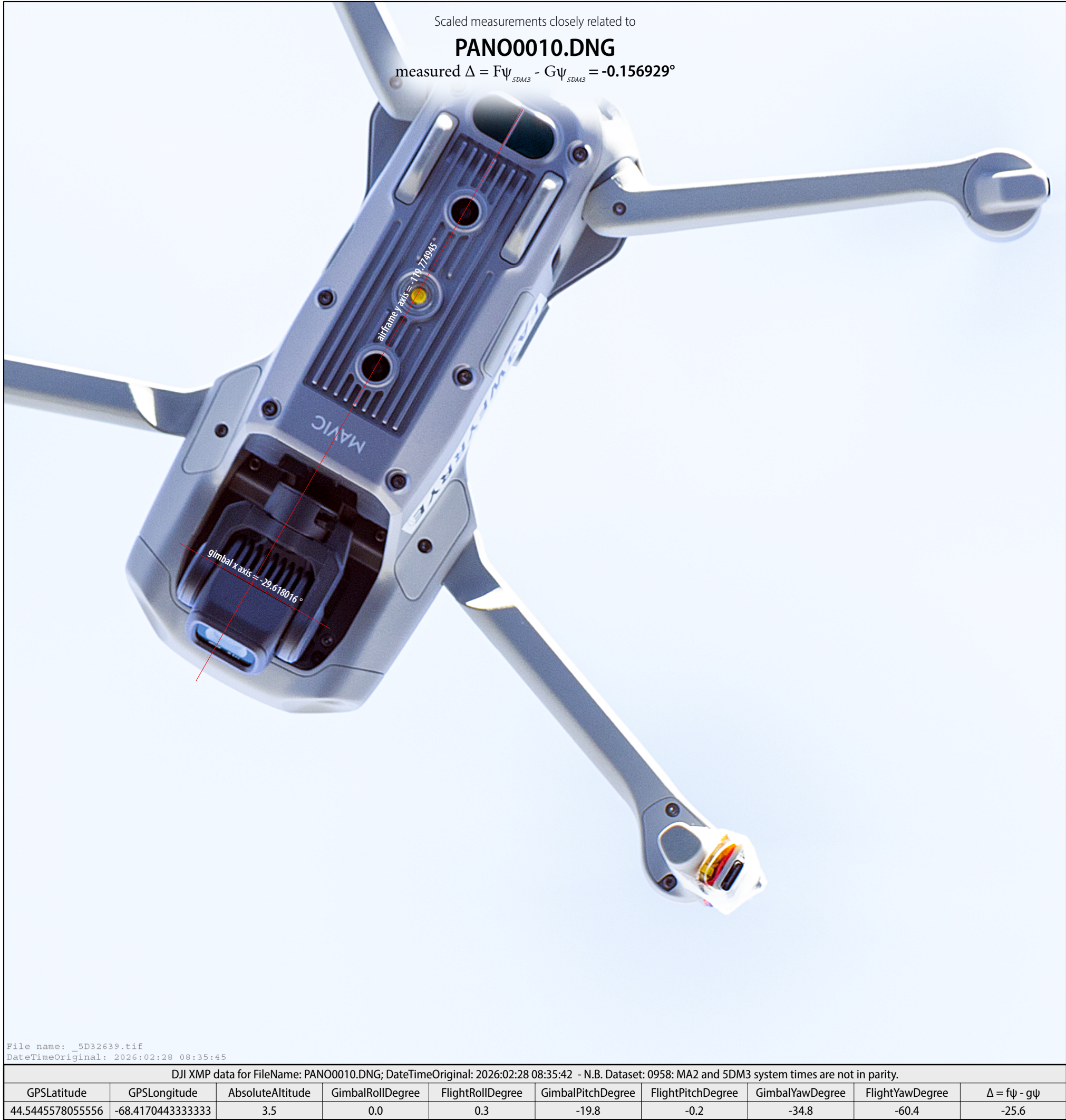
About these measurements

The image to the left [_5D32638.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0009.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.354758°, and not -25.4° as indicated in the DJI XMP's metadata.



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0010.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 3 = $\text{airframe y axis} - ((\text{ABS}(\text{gimbal x axis}) + 90) * -1)$

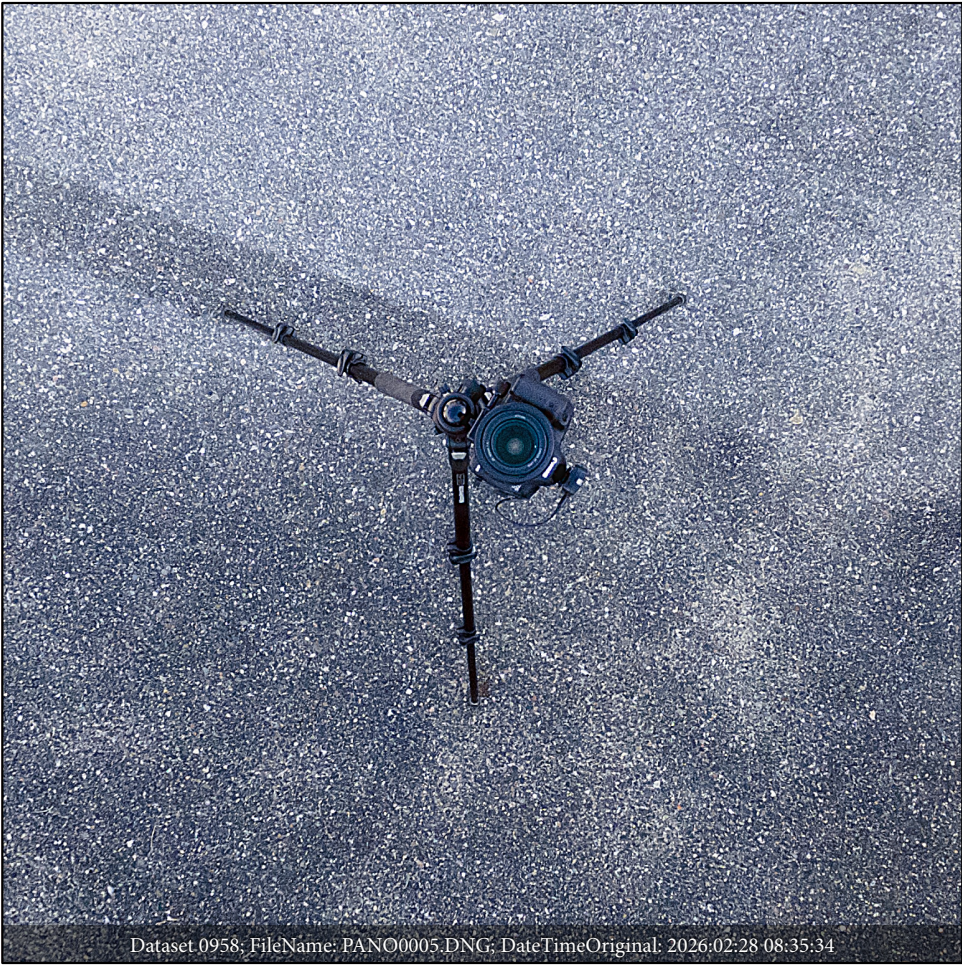
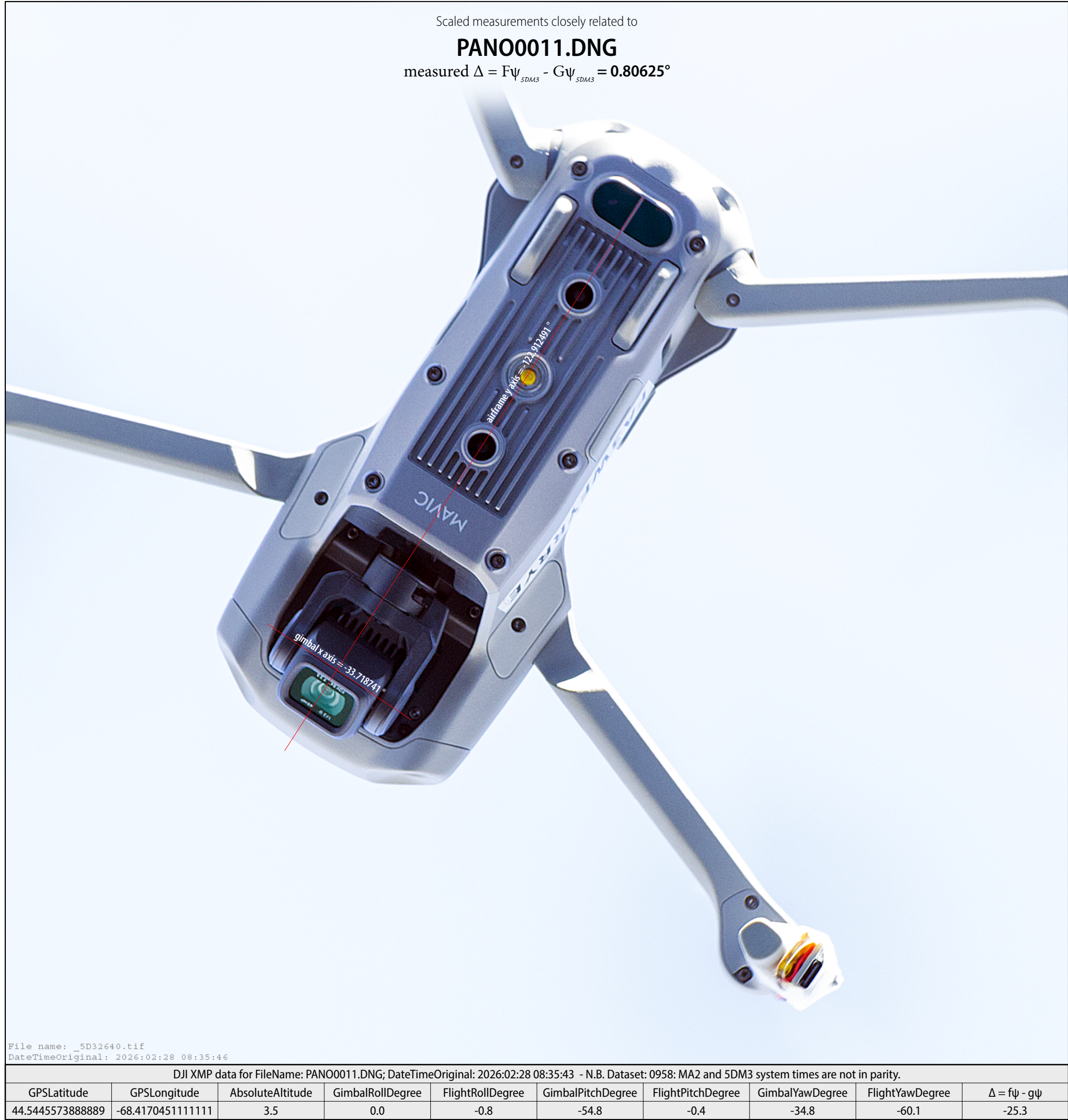
About these measurements

The image to the left [_5D32639.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0010.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is -0.156929°, and not -25.6° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0011.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 3 = $\text{airframe y axis} - ((\text{ABS}(\text{gimbal x axis}) + 90) * -1)$

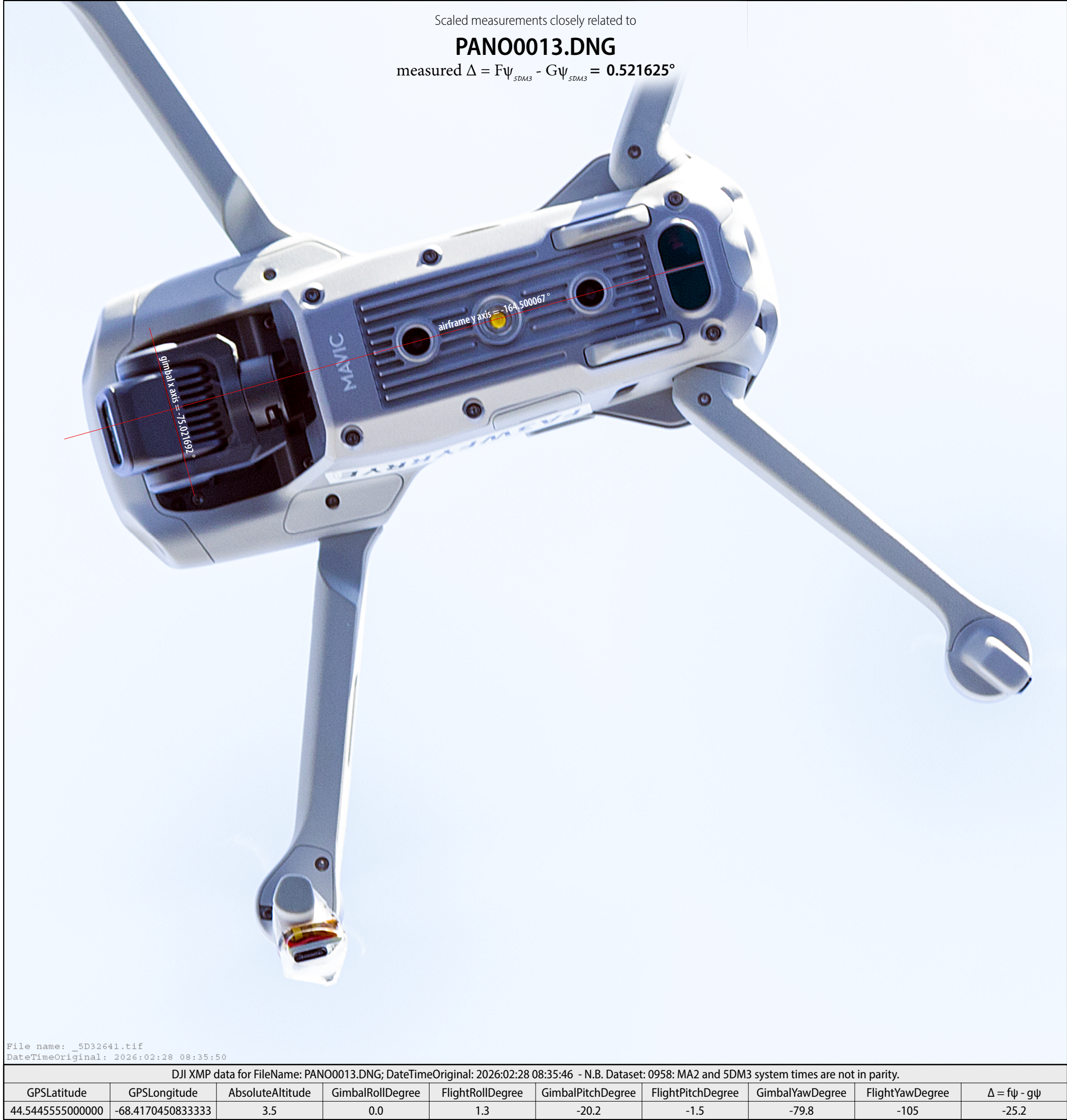
About these measurements

The image to the left [_5D32640.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0011.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.80625°, and not -25.3° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0013.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 3 =

airframe y axis

- ((ABS(gimbal x axis)+90)*-1)

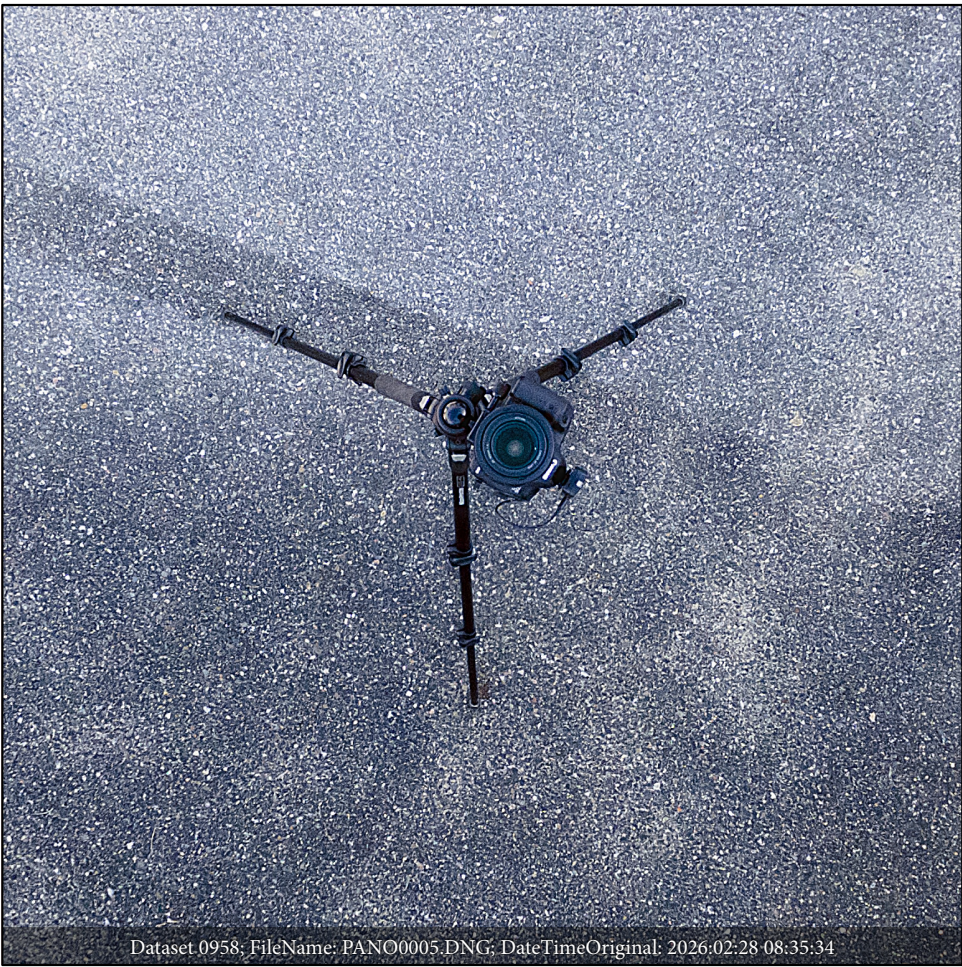
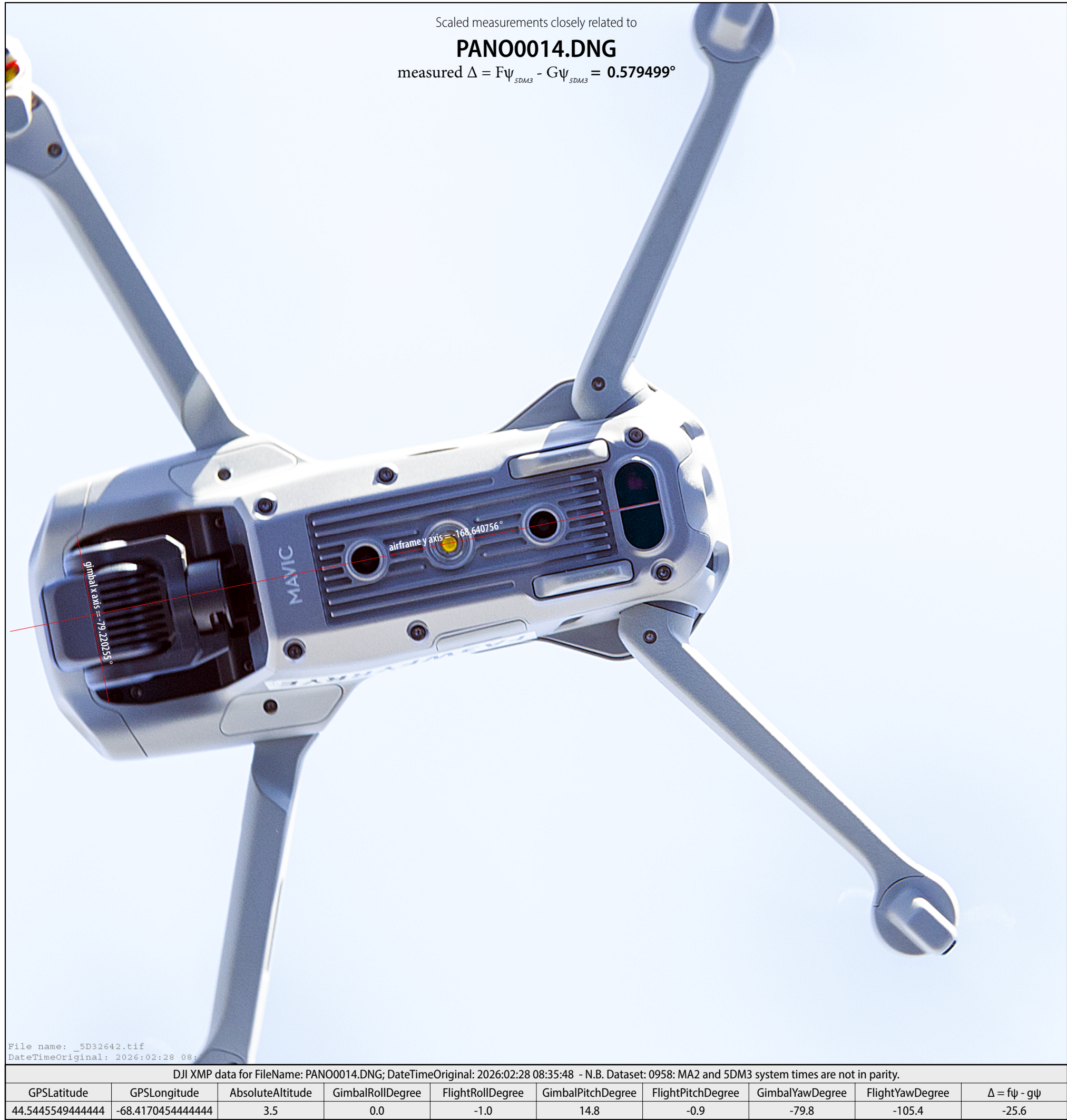
About these measurements

The image to the left [_5D32641.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0013.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.521625°, and not -25.2° as indicated in the DJI XMP's metadata.



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0014.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 3 = $\text{airframe y axis} - ((\text{ABS}(\text{gimbal x axis}) + 90) * -1)$

About these measurements

The image to the left [_5D32642.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0014.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.579499°, and not -25.6° as indicated in the DJI XMP's metadata.



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0015.DNG

measured $\Delta = F\psi_{5DM3} - G\psi_{5DM3}$

airframe in quadrant 4 = airframe y axis - (360 - (ABS(gimbal x axis) + 90))

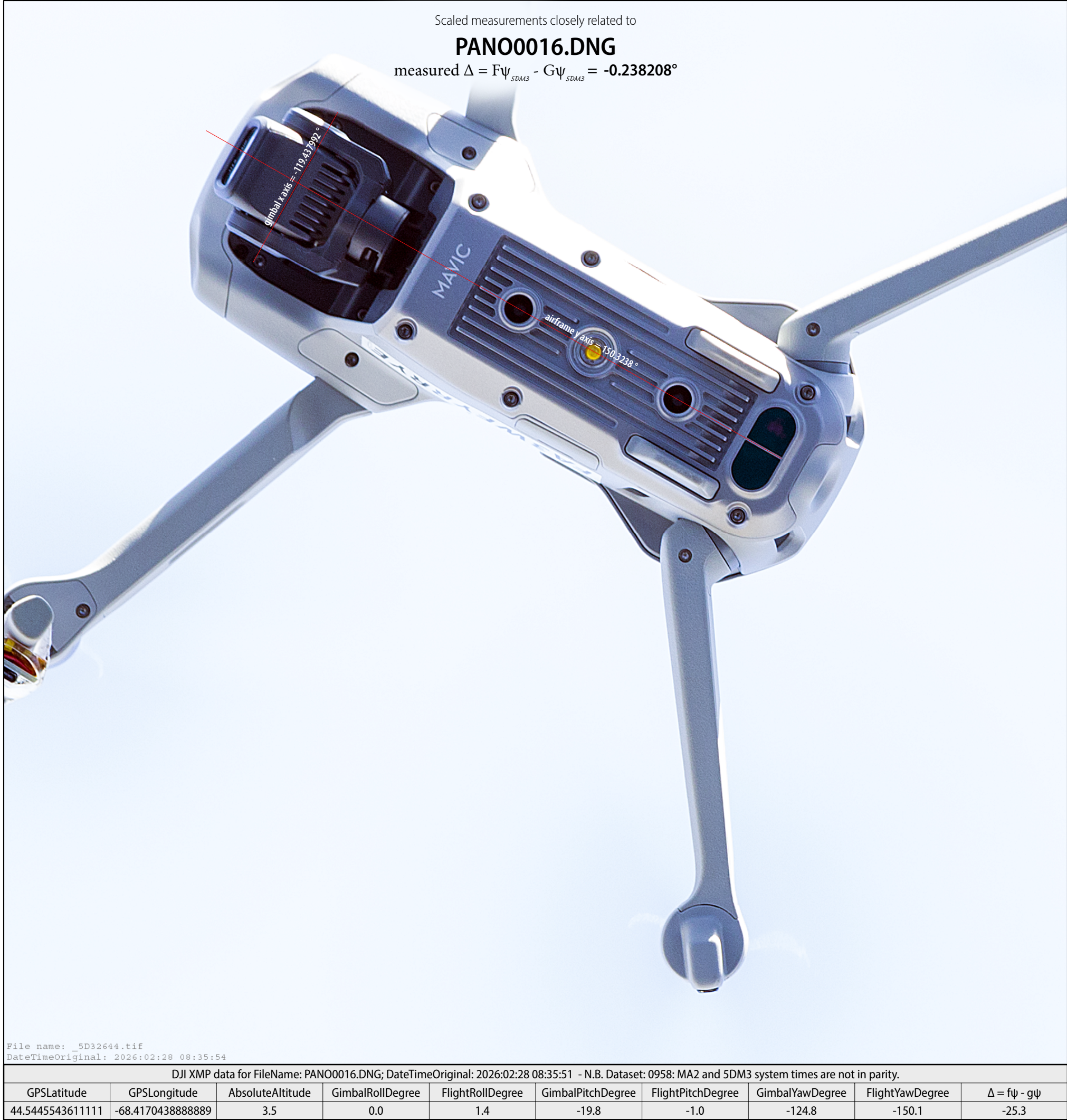
About these measurements

The image to the left [_5D32643.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0015.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is -0.344711° , and not -25.7° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0016.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 4 =

airframe y axis

 - (360 - (ABS(

gimbal x axis

) + 90))

About these measurements

The image to the left [_5D32644.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0016.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is -0.238208° , and not -25.3° as indicated in the DJI XMP's metadata.



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0017.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 4 = $\text{airframe y axis} - (360 - (\text{ABS}(\text{gimbal x axis}) + 90))$

About these measurements

The image to the left [_5D32645.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0017.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.063458°, and not -25.7° as indicated in the DJI XMP's metadata.



Dataset: 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0018.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 4 =

airframe y axis

- (360 - (ABS(gimbal x axis) + 90))

About these measurements

The image to the left [_5D32646.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0018.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is -0.006739° , and not -26.0° as indicated in the DJI XMP's metadata.



Dataset 0958; FileName: PANO0005.DNG; DateTimeOriginal: 2026:02:28 08:35:34

Scaled measurements closely related to

PANO0019.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 4 =

airframe y axis

- (360 - (ABS(gimbal x axis) + 90))

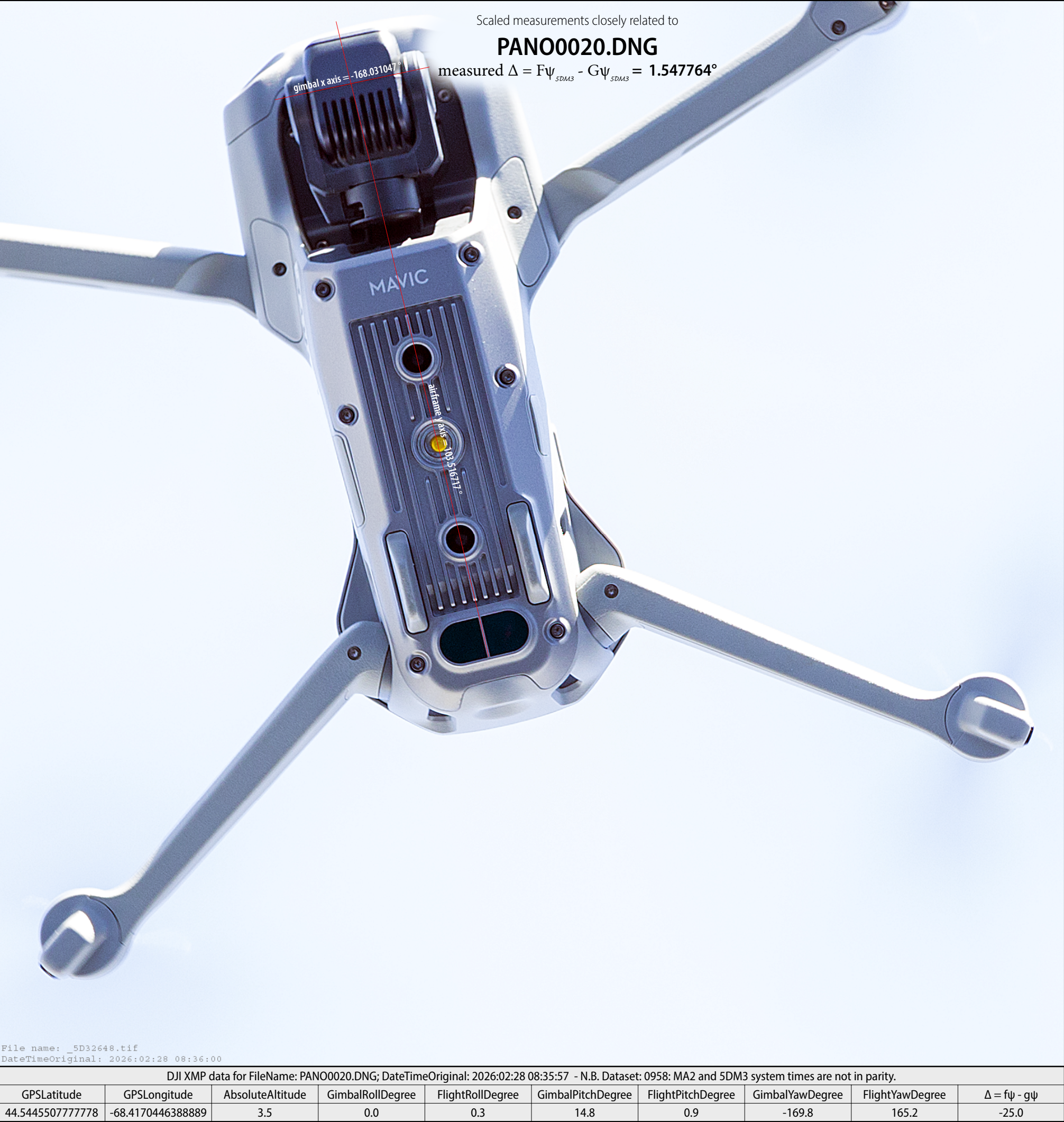
About these measurements

The image to the left [_5D32647.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0019.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.404114°, and not -25.6° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0020.DNG

$\text{measured } \Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 4 = airframe y axis - (360 - (ABS(gimbal x axis) + 90))

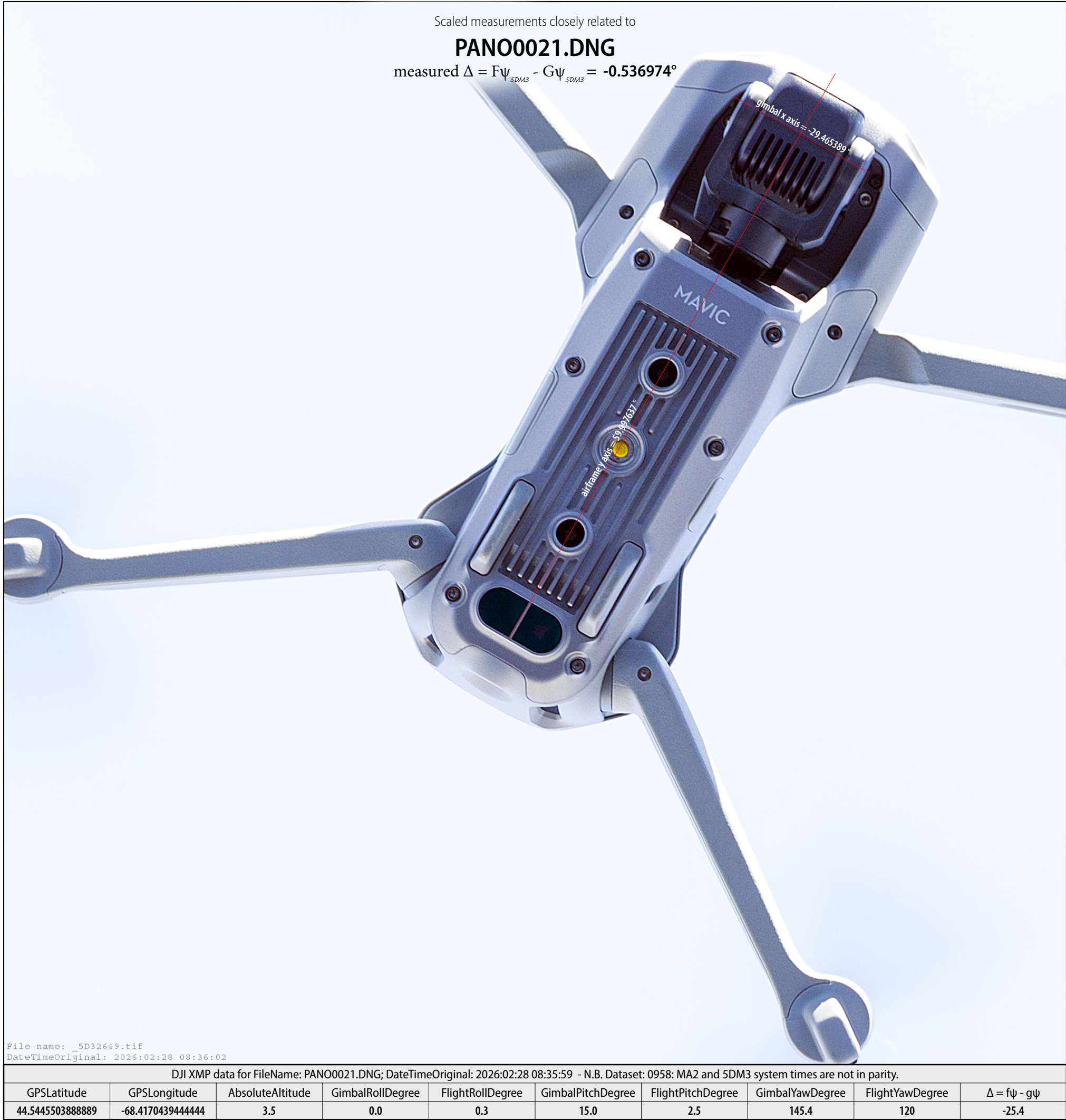
About these measurements

The image to the left [_5D32648.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0020.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 1.547764°, and not -25.0° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0021.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 1 = **airframe y axis** - (**gimbal x axis** + 90)

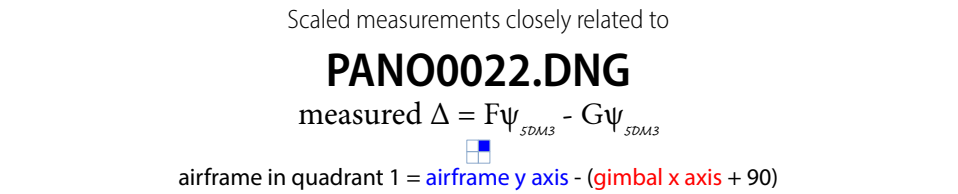
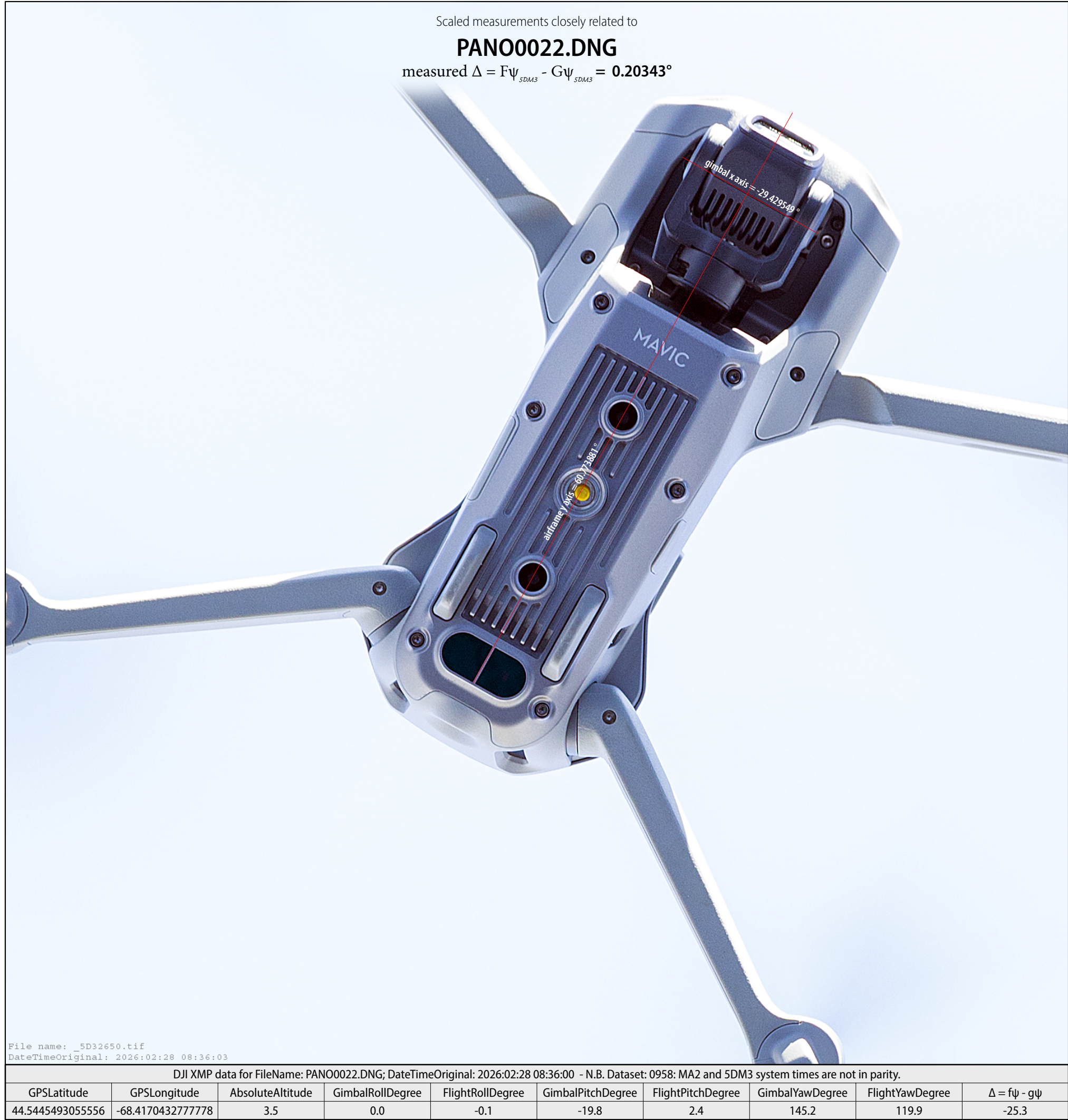
About these measurements

The image to the left [_5D32649.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0021.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is -0.536974° , and not -25.4° as indicated in the DJI XMP's metadata.



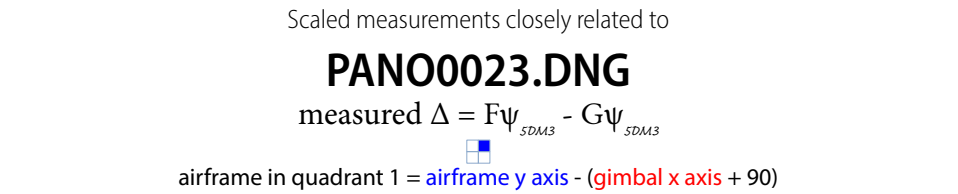
About these measurements

The image to the left [_5D32650.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0022.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.20343°, and not -25.3° as indicated in the DJI XMP's metadata.



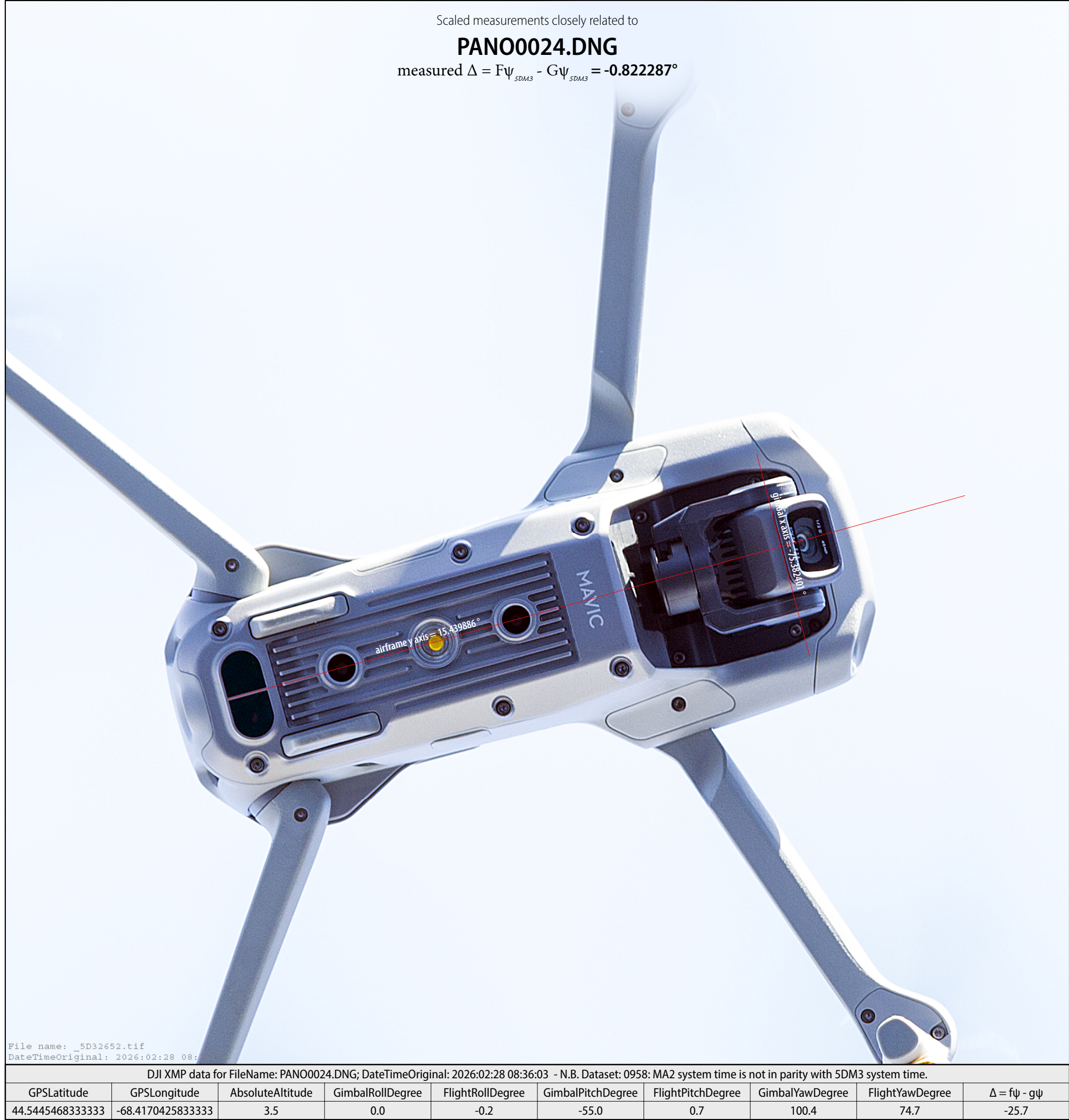
About these measurements

The image to the left [_5D32651.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0023.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.142083°, and not -25.7° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0024.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 1 = $\text{airframe y axis} - (\text{gimbal x axis} + 90)$

About these measurements

The image to the left [_5D32652.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0024.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.822287°, and not -25.7° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0025.DNG

measured $\Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 1 =

airframe y axis

 - (

gimbal x axis

 + 90)

About these measurements

The image to the left [_5D32653.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0025.DNG] in the dataset 0958.

The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 0.222948°, and not -26.0° as indicated in the DJI XMP's metadata.



Scaled measurements closely related to

PANO0026.DNG

$\text{measured } \Delta = F\psi_{SDM3} - G\psi_{SDM3}$

airframe in quadrant 1 =

airframe y axis

 - (

gimbal x axis

 + 90)

About these measurements

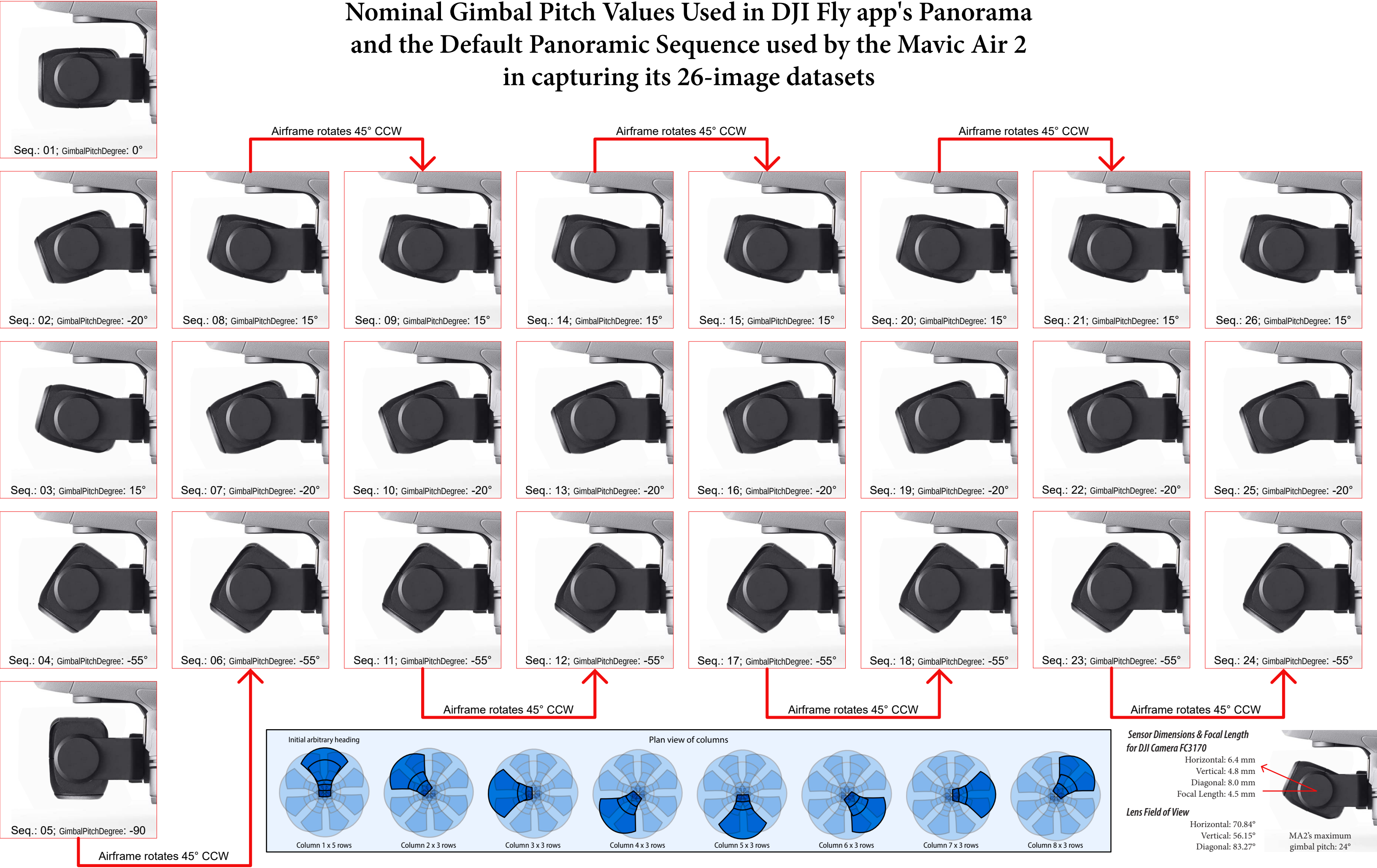
The image to the left [_5D32655.tif] was photographed using the Canon 5D Mark 3 (5DM3) at as nearly as possible at the same time as the DJI Mavic Air 2 (MA2) shot the photograph [PANO0026.DNG] in the dataset 0958.

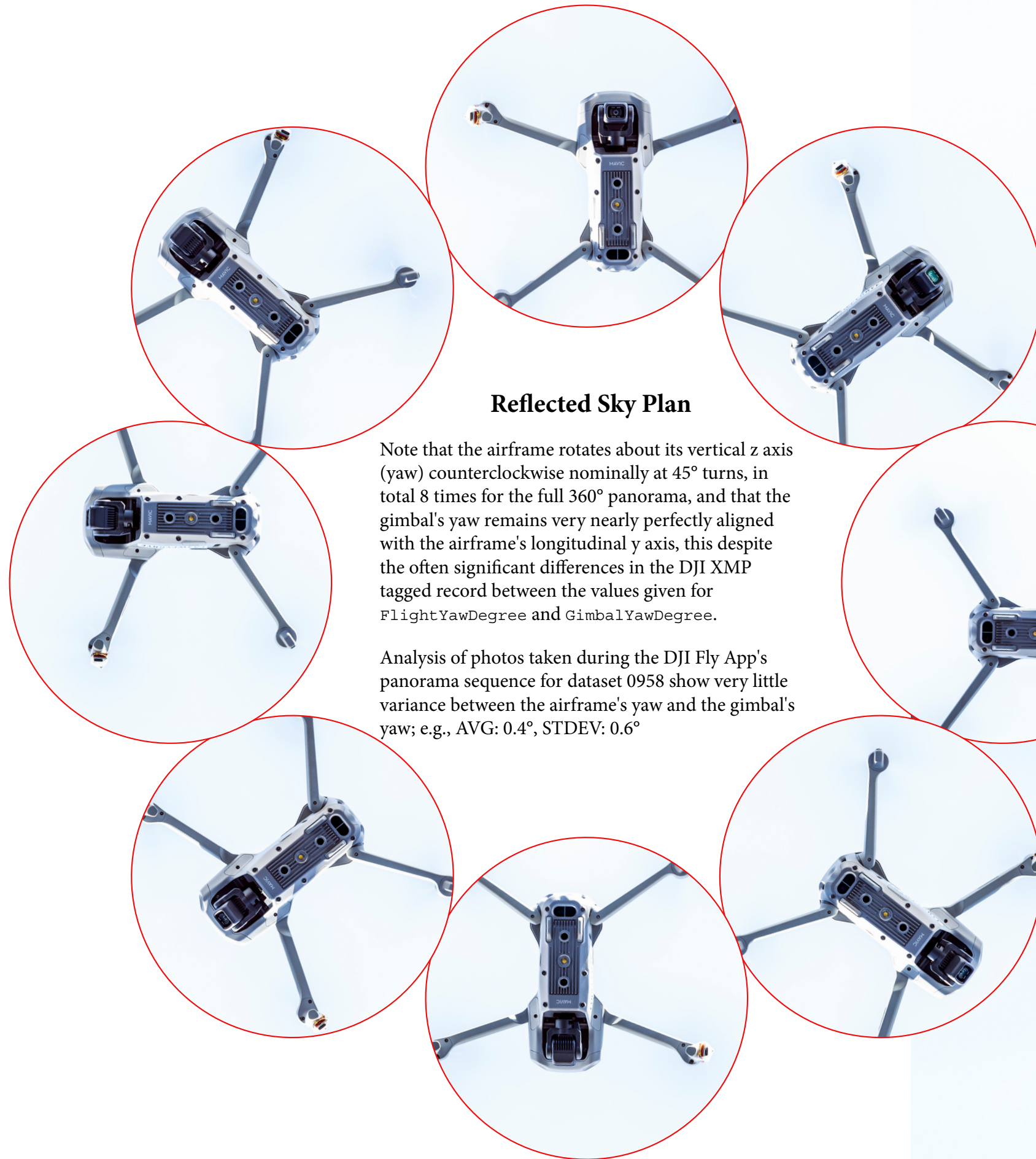
The purpose for doing this was to document the visual difference (*delta*, Δ) between the yaw of the airframe and the yaw of the gimbal. The reason for doing this was because of the often dubious and significant deltas between the DJI XMP tags, recorded for `FlightYawDegree` and `GimbalYawDegree`.

The image of the MA2 captured by the 5DM3, shown here close to full scale, shows 2 red lines, both of which have been labeled in decimal degrees. They were measured using Affinity Studio v3.0.3.4027. These values are without regard to geographic or magnetic orientation, but are instead representing the graphic angular value from a horizontal line, the x axis of the image. A positive value indicates a counter-clockwise rotation from the x axis; a negative value indicates a clockwise rotation.

The difference from the airframe's yaw and the gimbal's yaw is 1.158054°, and not -24.7° as indicated in the DJI XMP's metadata.

Nominal Gimbal Pitch Values Used in DJI Fly app's Panorama
and the Default Panoramic Sequence used by the Mavic Air 2
in capturing its 26-image datasets





Reflected Sky Plan

Note that the airframe rotates about its vertical z axis (yaw) counterclockwise nominally at 45° turns, in total 8 times for the full 360° panorama, and that the gimbal's yaw remains very nearly perfectly aligned with the airframe's longitudinal y axis, this despite the often significant differences in the DJI XMP tagged record between the values given for FlightYawDegree and GimbalYawDegree.

Analysis of photos taken during the DJI Fly App's panorama sequence for dataset 0958 show very little variance between the airframe's yaw and the gimbal's yaw; e.g., AVG: 0.4° , STDEV: 0.6°



